

**TEACHING GRIT: EXAMINING THE EFFECTS OF A SCHOOL-BASED
INTERVENTION TO FOSTER GRIT**

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Abstract

Non-cognitive skills, such as grit—defined as perseverance and consistency in pursuing long-term goals—have garnered increasing attention in education research. The current study explored grit’s relevance in the German educational context, addressing gaps in understanding its role, malleability, and potential to reduce achievement gaps for disadvantaged students. Using brief, web-based interventions tailored for secondary school students in Germany, the research aimed to foster grit and improve academic outcomes. Interventions targeted grit’s proposed psychological antecedents, namely academic mindsets and learning skills and strategies. Dependent variables included GPA, teacher evaluations of students’ progress, personal and school goal achievement, and educational attainment over five years.

The study employed a mixed-methods sequential explanatory design, combining the strengths of quantitative and qualitative approaches. The quantitative strand, prioritized in this design, included a cross-sectional pre-intervention study to examine the relationships between grit, its correlates, and school performance, followed by a cluster-randomized controlled longitudinal field quasi-experiment to evaluate the effects of grit interventions. Findings from the cross-sectional study revealed that school-specific grit uniquely predicted GPA, particularly for students with lower socio-educational advantage (SEA) and academic ability, with behavioral school engagement fully mediating this relationship. The longitudinal study revealed significant GPA improvements in the intervention groups, primarily for socially and academically disadvantaged students. Moreover, the grit interventions positively influenced the achievement of self-selected school goals and maintained GPA levels for advantaged, high-performing students, preventing the declines seen in the control group. The follow-up qualitative strand included focus groups with students grouped by academic progress post-intervention (improved vs. stagnated / declined), exploring their subjective experiences, the resonance of intervention content, and the potential behavioral mechanisms behind intervention success or failure. This integration of quantitative and qualitative findings deepened insights into grit’s impact on academic performance and intervention efficacy.

This research makes significant contributions to grit theory, methodology, and practice. It advances understanding of grit’s psychological antecedents, domain specificity, and mindsets and behaviors linking grit to academic outcomes. Methodologically, it employs a user-centered design process and a comprehensive, longitudinal evaluation, offering a model for scalable interventions. Practically, it provides schools with actionable tools to support students achieve better academic outcomes. These contributions emphasize the relevance of grit-focused strategies for educational policy and practice in Germany and beyond.

I dedicate this work to my late parents, Rodica and Cristi,
who gave me everything,
and to my children, David and Carla,
who bring healing and joy to my heart every day.

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List of Abbreviations

AM	Academic Mindsets
BPN	Basic psychological needs
BSCS	Brief Self-Control Scale
CFA	Confirmatory factor analysis
CFI	Comparative Fit Index
CI	Confidence interval
CI	Consistency of interests (grit facet), used only as grit-CI
CMIN/DF	Normed chi-square
COMB	Combined intervention condition (AM + LSS)
CPU	Central Processing Unit
DA	Dominance Analysis
DP	Deliberate practice
DV	Dependent variable
EFA	Exploratory factor analysis
EFL	English as a foreign language
EMM	Estimated Marginal Means
ESL	English as a second language
EU	European Union
GD	General Dominance
GLM	Generalized linear model
GPA	Grade Point Average
GSCA	Grit Scale for Children and Adults
GSO	Gesamtschule Bremen-Ost
HMR	Hierarchical multiple regression
ICC	Intraclass correlation coefficient
ICILS	International Computer and Information Literacy Study
ICSEA	Index of Community Socio-Educational Advantage
IGLU	Internationale Grundschul-Lese-Untersuchung
INSM	Initiative Neue Soziale Marktwirtschaft
IQ	Intelligence quotient
IQB	Das Institut zur Qualitätsentwicklung im Bildungswesen
IV	Independent variable
KIPP	Knowledge is Power Program
KMO	Keiser-Meyer-Olkin
LCA	Latent Class Analysis
LLC	Low-level certificate
LMM	Linear mixed model

LPA	Latent Profile Analysis
LRS	Learning Record Store
LSS	Learning Skills and Strategies
MCII	Mental contrasting with implementation intentions
MINT	Math, Informatics, Natural Sciences, Technology
ML	Maximum likelihood
MLC	Middle-level certificate
NOG	Neue Oberschule Gröpelingen
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
PE	Perseverance of effort (grit facet), used only as grit-PE
PERTS	Project for Education Research That Scales
PIAAC	Programme for International Assessment of Adult Competencies
PILRS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
RM	Repeated measures
RMSEA	Root Mean Square Error of Approximation
RQ	Research Question
RWA	Relative Weight Analysis
SD	Standard deviation
SE	Standard error
SEA	Socio-educational advantage
SEL	Social and emotional learning
SES	Socio-economic status
SMART	Specific, Measurable, Achievable, Relevant, and Time-Bound
STEM	Science, technology, engineering, and mathematics
TIMSS	Trends in International Mathematics and Science Studies
TLI	Tucker-Lewis Index
TMGS	Triarchic Model of Grit Scale
TMGT	Too-much-of-a-good-thing
U.K.	United Kingdom
U.S.	United States of America
UCD	User-centered design
ULC	Upper-level certificate
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIF	Variance inflation factor
WH	Working hypothesis
WOOP	Wish, Outcome, Obstacle, Plan

1 Introduction

*Mountains stand so tall,
each step shapes the climber's will,
grit moves through it all.*

(original haiku, 2024)

1.1 Rethinking the Skills Needed for Success

In most countries, the formal education system is struggling to keep up with the ever-growing and rapidly changing demands of life in the 21st century. While the percentage of students qualifying for tertiary education has steadily increased since the 1970s in Germany and Europe as a whole¹, the ratio of unemployed youth far exceeds the general unemployment rate. This raises concerns as to whether the knowledge and skills acquired through schooling are (still) pertinent to the needs of the labor market and whether they sufficiently prepare young people to overcome challenges and achieve their full potential.

Conventional educational approaches continue to focus on strengthening cognitive ability through the accumulation of content knowledge. This emphasis is reinforced by the types of assessments that tell us how well children perform academically, such as the international testing programs TIMSS, PISA, and PILRS². A growing body of research from psychology, neuroscience, education science, and economics suggests, however, that individuals' success and well-being in school and life depend not only on intellectual ability or innate talent but to a large extent also on certain personal qualities, which are given significantly less weight by current educational priorities (Almlund et al., 2011; Borghans et al., 2008; Morrison Gutman & Schoon, 2013; Robbins et al., 2004; Yeager & Walton, 2011).

There is no scarcity of names for these individual attributes in the literature: non-cognitive skills (or traits/factors), personal qualities, character skills (or strengths), virtues, dispositions, social and emotional learning competencies, psychosocial skills (or abilities/attributes), developmental assets, soft skills, and so on. For every mention of trait, characteristic, or attribute—terms that imply stability—there is at least one corresponding mention of skill or competency—terms that imply plasticity (Duckworth & Yeager, 2015). To complicate matters further, many of these presumably mutable abilities are interlinked with

¹ See the national report on education Bildung in Deutschland 2022 (Autor:innengruppe Bildungsberichterstattung, 2022a) for detailed information about the German education system.

² Trends in International Mathematics and Science Studies, Programme for International Student Assessment (OECD), and Progress in International Reading Literacy Study.

the ‘Big Five’ personality traits³, which are thought to be relatively stable.

Some of the key attributes that have been analyzed in relation to academic achievement and socio-economic attainment include self-esteem, self-efficacy, self-control, metacognitive strategies, resilience and coping, motivation, social competencies, creativity, (academic) mindsets, curiosity, and perseverance/grit (Duckworth & Yeager, 2015; Kautz et al., 2014; Morrison Gutman & Schoon, 2013; Zhou, 2016). These qualities emerge as critical predictors of success, often rivaling or exceeding cognitive abilities in their influence on educational attainment, labor market performance, and social-emotional welfare. For instance, Boehnke (1996) found that students’ self-confidence (understood as self-esteem/self-efficacy) and their rule abidance at school (which depends also on self-control) are more important for school performance than intelligence. The development of these non-cognitive attributes holds promise for reducing educational disparities and improving long-term outcomes for young people. Evidence suggests that targeted interventions, particularly in early life, can foster behaviors and attitudes that drive sustained effort, adaptability, and resilience. Collectively, these qualities “facilitate goal-directed effort ..., healthy social relationships ..., and sound judgment and decision making ... and powerfully predict academic, economic, social, psychological, and physical well-being” (Duckworth & Yeager, 2015, p. 237).

Among these attributes, grit, defined as “perseverance and passion for long-term goals” (Duckworth et al., 2007, p. 1087) has arguably received the lion’s share of attention from scholars and journalists in recent years, not least because of psychologist Angela Duckworth’s very popular TED talk on the topic (viewed almost 35 million times since 2013) and her 2016 New York Times bestseller *Grit: The Power of Passion and Perseverance*⁴.

The concept of grit, which refers to particles of sand or stone, has been used colloquially since the 19th century to describe courage and determination despite difficulty. In 2007, U.S. psychologists redefined grit as a non-cognitive skill essential for achievement, comprising two facets: perseverance of effort and consistency of interests (Duckworth et al., 2007). Despite its strong association with conscientiousness—a personality trait encompassing self-control, industriousness, and responsibility—grit is distinguished by its emphasis on commitment to valued interests over long periods of time. This unique focus differentiates grit also from other related constructs such as self-control, which deals with immediate distractions, and resilience, which emphasizes recovery from adversity rather than proactive goal pursuit. Within Park et al.’s (2017) tripartite taxonomy of character in school-

³ Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.

⁴ TED Talk: https://www.ted.com/talks/angela_lee_duckworth_grit_the_power_of_passion_and_perseverance

age children, grit is classified as an intrapersonal attribute essential for goal-directed effort⁵.

Numerous studies have underscored the importance of grit in predicting a wide array of success outcomes of personal, academic, and professional nature, making grit an important focus of psychological and educational research (for literature reviews on grit, see Allen et al., 2021; Almeida, 2016; Christopoulou et al., 2018; Credé et al., 2017; Datu et al., 2017b; Datu, 2021; Fernández-Martín et al., 2020; Hou et al., 2021; Lam & Zhou, 2019; Liang, 2021; Pendyala & Vyas, 2023; Roach, 2023; Sanguras, 2021; Schimschal et al., 2021; and Stoffel & Cain, 2018). In education, grit has been identified as a significant predictor of outcomes such as grades, engagement, retention, and overall educational attainment. It has also been shown to play a protective role against psychosocial challenges, including stress, anxiety, and social adversity. Notably, grit appears to benefit particularly disadvantaged students, helping them overcome challenges to success at all levels of education (e.g., Hodge et al., 2018; Huang & Zhu, 2017). Beyond academic settings, grit has been linked to performance and persistence in high-pressure fields such as healthcare, the military, teaching, and sports.

Despite its widespread acclaim, the conceptualization and measurement of grit have faced intense scrutiny. Original instruments, such as the Grit-O and Grit-S scales, have been criticized for methodological limitations and a comparatively poorer fit in collectivistic cultures, prompting the development of multiple context-specific or culturally-adapted scales. Critics have also pointed out potential downsides of grit, such as encouraging perfectionism or persistence in harmful or unrealistic goals (e.g., Lucas et al., 2015). Ethical concerns have also been raised, with some arguing that promoting grit in education shifts the responsibility for failure onto students while overlooking systemic inequities (e.g., R. M. Cohen, 2015). Even so, interest in grit shows no signs of fading—quite the opposite. Since Duckworth et al.'s (2007) seminal article, over 1,000 peer-reviewed studies have explored grit⁶, with the vast majority affirming its relevance and predictive power across a wide range of educational and life outcomes, further solidifying its appeal among researchers and practitioners alike.

1.2 Research Rationale, Objectives, and Significance

Beyond the unspoken catalyst for much scholarly work to ‘see what the hype is all about’, and beyond the motivation to address specific research gaps, the concept of grit is central to this doctoral project for a highly practical reason. It is intuitively plausible that

⁵ The interpersonal, intrapersonal, and intellectual dimensions of character reflect how children relate to others, manage their goals and impulses, and engage with concepts and ideas, respectively.

⁶ This figure is based on a thorough literature search conducted for this project and includes, aside from a handful of articles available only in German, solely studies published in English. It is worth noting that many additional studies on grit exist in other languages not covered in this search.

grittier students—those who work harder and persist longer toward their goals despite obstacles or setbacks—are more likely to succeed than less gritty peers of equal ability. Consequently, if grit were susceptible to interventions, a prospect yet to be confirmed, it would be a logical and worthwhile endeavor to cultivate it in the classroom. Cost-effective ‘grit sessions’ could be integrated into school curricula easily, providing students with critical support in an area often overlooked by traditional education.

A second rationale stems from a significant contextual gap in grit research. To date, most studies on grit have been conducted in the U.S., with limited attention given to European contexts, and even less to Germany specifically. At the same time, Germany’s highly stratified education system and pronounced socioeconomic and migration-related disparities in academic achievement (Maaz et al., 2015; OECD, 2023) underscore the need for tools—both curricular and extracurricular—that can help bridge these gaps, offering a unique opportunity to examine grit’s relevance within this specific setting. Existing studies suggest that interventions targeting grit-related factors, such as growth mindset and deliberate practice, tend to benefit students who struggle academically and those from disadvantaged backgrounds (Paunesku et al., 2015; Santos et al., 2021; Yeager, Walton, et al., 2016). Thus, if these findings prove reliable, grit holds promise for education policy and practice anywhere but may be particularly relevant in the German educational context.

Grounded in these two core motivations, the proposed research aims to conduct the first school-based intervention in Germany specifically designed to foster grit⁷. More precisely, the goal is to enhance grit among secondary-school students in Bremen (Germany) through brief, theoretically-driven, web-based interventions. As no such tools currently exist for the German-speaking context, a key objective is to develop two novel grit interventions: one focusing on mindsets and the other on skills and strategies, based on a theoretical model of grit outlined in Chapter 3. The study will test the relative and combined effectiveness of these interventions in fostering grit and improving both personal and academic outcomes.

The ultimate aim of this doctoral project is to add to the repertoire of ideas and tools that educators and education policymakers can employ in their quest to reduce achievement gaps and empower all children to reach their full potential. The immediate research objectives

⁷ To the best of my knowledge, no such project exists in Germany. However, a team at the University of Cologne has implemented workshops for high school seniors, led by university guidance counselors, which targeted the *value* and *expectancies for success* students attach to STEM fields (see Beckmann & Fervers, 2024). These workshops included a utility value intervention to enhance the perceived relevance of STEM subjects and a growth mindset intervention to foster students’ beliefs in their ability to succeed in these fields. Moreover, Zeeb et al. (2020) demonstrated that a lesson-integrated mindset training among 7th-grade secondary school students in Germany, supported by teacher feedback, positively influenced students’ growth mindsets and buffered against demotivation in physics.

are multifaceted and informed by the gaps and opportunities identified in existing research.

While grit has been studied widely, its psychological antecedents—beliefs, expectations, values, emotions, motivations, or skills that may enable someone to be gritty—remain insufficiently understood, as does their potential as targets for intervention. This study aims to advance the theoretical understanding of how grit develops and operates by identifying the intrapersonal factors most likely to contribute to its formation. Of particular interest are academic mindsets, such as growth mindset, sense of purpose, and school belonging, as well as learning skills and strategies like deliberate practice, self-control, and goal-setting. By proposing and testing a causal model of grit, the research aims to clarify how these two types of antecedents interact to promote perseverance, facilitate goal achievement, and enhance academic outcomes, providing a focused framework to inform future research.

Furthermore, grit is frequently linked to academic achievement, but the mechanisms underlying this relationship remain unclear. This study examines behavioral mediators, such as school engagement, and contextual moderators, including socio-educational (dis)advantage and academic ability, which may influence the strength or direction of this relationship. It also explores the role of the performance domain, investigating how grit interventions affect both students' pursuit of self-selected goals and their objective academic performance. By addressing these gaps, the research aims to provide a deeper understanding of how and to what extent grit impacts various student outcomes.

Theoretical concerns about grit also center on its discriminant validity relative to constructs like conscientiousness, self-efficacy, and self-control, as well as its explanatory power beyond these established predictors of academic and socio-economic success (Credé et al., 2017). In response, this study investigates the unique contribution and relative importance of domain-general and school-specific grit to students' end-of-term GPA, compared to related attributes, while also hoping to provide nuanced insights into grit's domain-specificity.

Methodologically, grit research has often been limited by its reliance on cross-sectional designs, narrow (quantitative) outcome measures, and homogeneous, high-performing samples, which restrict the generalizability of findings. To address these limitations, this project employs a longitudinal, mixed-methods design, spanning multiple follow-ups over five years, to capture both variations in grit and the interventions' short- and long-term effects on academic outcomes in a diverse student sample. The research expands the scope of outcomes to include objective metrics, such as GPA and teacher evaluations⁸, as

⁸ Neither of which are entirely objective, as will be discussed in sections 5.8.1 and 10.3.1.

well as subjective, self-selected goals, offering a more comprehensive understanding of grit's impact. Additionally, the study incorporates a qualitative strand to explore participants' subjective experiences, the resonance of intervention content, and the mechanisms behind intervention success or failure, bridging the gap left by purely quantitative approaches.

In addition, as part of its methodological contributions, this research aspires to provide a best practice example for rigor in intervention design and evaluation. It employs a user-centered design (UCD) process to develop tailored, web-based grit interventions that are both theory-driven and responsive to the needs and interests of middle school students in Germany. By incorporating iterative feedback from students and teachers, the study aims to create interventions that are relevant, engaging, and scalable.

In terms of its practical significance, this research explores how grit interventions can support disadvantaged and lower-ability students within the German educational context. Specifically, the project aims to provide actionable strategies for fostering perseverance and academic tenacity among students facing systemic challenges. With their anticipated cost-effectiveness and scalability, the web-based interventions could be implemented broadly across German-speaking countries, with minor adaptations for local contexts. By focusing on grit's practical application to enhance school performance and goal achievement, the study contributes to ongoing efforts to equip students with non-cognitive skills essential for success.

These diverse objectives give rise to a set of detailed research questions (RQs), presented in section 2.9, and position the current project to make meaningful contributions to both the academic understanding of grit and its practical application. By bridging gaps in theoretical knowledge, addressing methodological limitations, and emphasizing practical relevance, this study aims to advance grit research while offering tools and insights that benefit students, educators, researchers, and policymakers alike.

1.3 Project Structure and Chapter Overview

This doctoral project is divided into three distinct phases. The *intervention development* phase (Chapter 4) is a mixed-methods study in its own right, focusing on the user-centered design and pilot testing of the web-based grit interventions. Figure 4.1 (p. 61) offers a visual overview of this phase. The *implementation* phase represents the quantitative strand of the main study's mixed-methods sequential explanatory design. It includes a cross-sectional study examining the pre-intervention relationships between grit, its correlates, and academic performance (Chapter 7), as well as a cluster-randomized controlled longitudinal quasi-experimental study investigating the effects of the grit interventions on various outcomes (Chapter 8). With follow-ups extending up to five years post-intervention, this

study addresses key limitations in grit research, such as the scarcity of longitudinal data and the need for robust causal analyses. The *evaluation* phase (Chapter 9), representing the qualitative strand of the main study, delves into students' reflections on factors influencing their academic trajectories and their experiences with the grit interventions. By integrating these strands (Chapter 10), the mixed-methods design enables both breadth and depth of analysis, offering a nuanced understanding of grit's impact and the behavioral mechanisms underlying the interventions' influence on academic performance and goal achievement. Figure 5.1 (p. 100) provides a comprehensive model to help visualize the stages, procedures, and outcomes of the main study's mixed-methods design.

In addition to the current chapter, which introduces the project, this dissertation comprises nine further chapters, each outlined briefly below. These ± 100 -word summaries offer an overview of the chapters' focus and scope, guiding readers through the dissertation without revealing specific findings before they are discussed in detail.

Chapter 2 provides a comprehensive review of grit, contextualizing it as a non-cognitive skill within the conscientiousness family and distinguishing it from related constructs like self-control and resilience. It explores grit's motivational, cognitive, and behavioral correlates, as well as its strong association with achievement across diverse contexts, including career development, healthcare, the military, teaching, sports, and particularly education. Moreover, the chapter examines the measurement of grit and its responsiveness to interventions, while addressing criticisms such as its potential maladaptive effects and the ethical concerns surrounding its promotion. Finally, it highlights gaps in the literature, particularly the lack of research on grit within the German educational context.

Chapter 3 establishes the theoretical basis for understanding grit as a multifaceted construct shaped by beliefs, motivations, and skills. It examines psychological antecedents of grit—such as interest, purpose, practice, hope, mindfulness, self-control, and goal-setting—alongside models of non-cognitive factors in education. By comparing these perspectives, the chapter identifies those (overlapping) beliefs and skills most relevant for school achievement, organizing them into two categories: academic mindsets and learning skills and strategies. It then introduces a streamlined causal model linking these antecedents to grit and performance outcomes. This framework underpins the design of grit interventions and their evaluation within the German middle school context.

Chapter 4, conceptualized as a separate pilot study, details the iterative development and testing of two web-based grit interventions tailored for German secondary school students. It outlines the use of a design-thinking, user-centered approach to adapt and refine

materials, integrating feedback from teachers and students to ensure both technical and pedagogical usability. The chapter details the feasibility and usability testing phases, addressing challenges encountered during pilot testing and the solutions implemented to improve engagement and accessibility. It concludes with insights into scaling web-based psychological interventions in real-world educational settings, highlighting the importance of context-specific adaptation and iterative refinement for their effective implementation.

Chapter 5 outlines the research design and methodologies for examining the effects of the grit interventions among secondary school students in Bremen. It details the main study's mixed-methods sequential explanatory approach, combining a quantitative strand centered on a school-based quasi-experiment with a qualitative strand involving focus groups with intervention participants. The chapter covers the study's design, population, sampling strategies, instruments, outcome measures, procedures, and analytical approaches. It also addresses methodological challenges, highlights the benefits of combining quantitative longitudinal data with qualitative feedback, and emphasizes ethical rigor, providing a broad framework for understanding the grit interventions' impact on academic outcomes.

Chapter 6 details the rigorous process undertaken to prepare and validate the dataset for analysis, ensuring accuracy and reliability in examining the outcomes of the grit interventions. It explains handling missing data through listwise deletion, addressing outliers through bootstrapping, and testing key assumptions like normality and multicollinearity. The chapter covers the dimensionality and construct validation of psychological and academic measures, including grit, school belonging, self-control, and self-efficacy, using exploratory and confirmatory factor analyses. It also discusses grade normalization across course levels to ensure fair GPA comparisons. Emphasizing methodological transparency, it combines robust statistical techniques with careful consideration of construct stability and validity over time.

Chapter 7 examines the pre-intervention relationships between grit (both domain-general and school-specific), conscientiousness, school-specific self-control and self-efficacy, implicit theories of intelligence, school belonging, behavioral school engagement, and academic performance (end-of-term GPA). Using rigorous statistical analyses, the chapter addresses key research questions about the associations between grit and its correlates, their combined impact on GPA, and grit's relative importance as a predictor. It also investigates the mediating role of school engagement and examines moderating factors such as socio-educational (dis)advantage and academic ability. This comprehensive analysis highlights grit's relevance within this educational context, emphasizing its potential role in fostering student engagement and improving achievement.

Chapter 8 examines the effects of two grit interventions—targeting academic mindsets and learning skills and strategies—and a combined approach, on self-reported grit, related psychological variables, school engagement, GPA, personal and school goal achievement, teacher evaluations, and long-term educational attainment. Using a longitudinal design spanning five years, the chapter evaluates whether grit can be enhanced through intervention, whether the interventions improve students' GPA, which groups of students benefit most, and whether engagement mediates the relationship between the grit interventions and academic outcomes. Additionally, it analyzes the relative effectiveness of each intervention and emphasizes treatment-effect heterogeneity, showcasing how impacts vary across different student subgroups and outcomes.

Chapter 9 presents the qualitative strand of the research, exploring students' perspectives on school, learning, and the grit interventions. Based on qualitative data from focus groups, the chapter explores differences in student perspectives across academic trajectories and cohorts, analyzing how the interventions may have influenced attitudes, behaviors, and outcomes. The findings provide nuanced insights into students' engagement with the content, their reflections on its applicability, and the external and internal factors influencing their academic progress, while also discussing the anticipated implications of integrating grit principles into school curricula. This qualitative analysis complements the study's quantitative findings, offering a richer understanding of the interventions' impact.

The final chapter synthesizes key findings from both research strands. It emphasizes the role of school-specific grit in academic performance, particularly for disadvantaged and lower-ability students, and explores how intervention effects depend also on teacher mindsets, peer norms, and institutional cultures. Integrated Results Matrices juxtapose quantitative and qualitative findings to illustrate convergent, complementary, and divergent outcomes. The discussion links these results to existing theories, underscores the need for context-sensitive, scalable approaches addressing individual and environmental barriers to success, and provides practical recommendations for fostering grit in schools. The chapter concludes with an evaluation of the project's limitations and contributions, and suggestions for future grit research in the German educational context.

2 What We Know, What We Don't, and What We're Asking about Grit

2.1 What Grit Is

The term grit has been used in American English since the early 1800s to denote a strength of character that blends courage, fortitude, and stamina. The Oxford English Dictionary categorizes grit as “originally U.S. slang” and defines it as “firmness or solidity of character; indomitable spirit or pluck; stamina” (Oxford English Dictionary, n.d.). Grit is also described as “firmness of mind or spirit : unyielding courage in the face of hardship or danger” (Merriam-Webster Dictionary, n.d.).

The earliest use of grit as a quality of character is attributed to the 19th century American novelist Nathaniel Hawthorne, who, in reference to a British poet, wrote that “his main deficiency was a lack of grit” (Hawthorne 1863, p. 179, as cited in Ris, 2015, p. 3). In one of the first systematic reviews of the psychological determinants of success, Galton (1892) found that prominent individuals displayed “zeal” and the “capacity for hard labor” (p. 38, as cited in Duckworth & Eskreis-Winkler, 2015, p. 397), while Cox (1926), who studied geniuses, asserted that “youths who achieve eminence are characterized not only by high intellectual traits, but also by *persistence of motive and effort* [emphasis added]” (p. 218, as cited in Duckworth & Eskreis-Winkler, 2015, p. 397).

In 2007, a group of U.S. psychologists reclaimed the term grit to denote a non-cognitive trait or personal quality that is vital to (objective/measurable) achievement regardless of domain. “Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress. The gritty individual approaches achievement as a marathon; his or her advantage is stamina” (Duckworth et al., 2007, pp. 1087–1088). These authors conceptualized grit as a higher-order construct with two lower-order dimensions that are related but distinct: *Consistency of interests* (sometimes referred to as passion, consistency, grit-interest, grit-consistency, or grit-CI), measured by items such as ‘New ideas and projects sometimes distract me from previous ones’, and *perseverance of effort* (sometimes referred to as simply perseverance, grit-effort, grit-perseverance, or grit-PE), measured by items such as ‘I finish whatever I begin’⁹. While perseverance reflects sustained effort toward long-term goals despite setbacks, consistency represents the tendency to maintain interest in these goals over time. Although certain types of outcomes seem to be predicted more strongly by one or the other dimension (more on this

⁹ Hereafter, I will refer to these facets as consistency (of interests)/perseverance (of effort) or as grit-CI/grit-PE.

below), grit's pioneering proponents suggested that the two together have higher predictive power than either alone and both may be needed for success (Duckworth et al., 2007, 2009, 2011; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014, 2016).

Popular opinion holds that grit belongs to the Big Five Conscientiousness family (e.g., Credé et al., 2017; Duckworth & Eskreis-Winkler, 2013, 2015; Eskreis-Winkler et al., 2014; Lechner et al., 2019; MacCann & Roberts, 2010; Roberts et al., 2014). Conscientiousness is one of the five fundamental personality traits included in the Big Five taxonomy of personality, alongside extraversion, agreeableness, openness to experience, and neuroticism and it has been defined as “a spectrum of constructs that describe individual differences in the propensity to be self-controlled, responsible to others, hardworking, orderly, and rule-abiding” (Roberts et al., 2014, p. 1315). Though there remains disagreement regarding the hierarchical structure of the conscientiousness domain, four lower order dimensions or *facets* have been reliably identified in the extant literature, namely orderliness, industriousness, self-control, and responsibility. Most of the other likely facets, such as traditionalism / conventionality, persistence / perseverance, decisiveness, or punctuality have been found in at least two published studies (Eisenberg et al., 2014; Roberts et al., 2014).

The nomological network of conscientiousness is large—and seemingly still growing—and includes several notable psychological constructs that do not necessarily originate in personality psychology, for instance grit (from positive psychology), impulsiveness / constraint (from clinical psychology), achievement-striving and goal-setting (from social psychology), and effortful control, delay of gratification, or ego control (from developmental psychology). Roberts et al. (2014) further specify that some of these components may be regarded as *trait* manifestations of conscientiousness—relatively stable patterns of thoughts, feelings, and behaviors—while others may be better understood as *state* manifestations that reflect “moment-to-moment fluctuations in functioning” (p. 1316). Grit, for its part, is typically seen as a dispositional (though malleable) trait, rather than an activity-specific state (Southwick et al., 2019). Grit's supposed plasticity is discussed in more detail in section 2.6.

Finally, grit is classified as an *intrapersonal* character strength, according to a tripartite taxonomy of character proposed by Park et al. (2017). This framework, supported by findings from several longitudinal studies, identifies three character domains: intrapersonal (grit, academic self-control), interpersonal (interpersonal self-control, gratitude, social intelligence), and intellectual (zest, curiosity). One “could also call them strengths of will, heart, and mind” (Duckworth, 2016, p. 273). The taxonomy demonstrates discriminant validity, as the three domains are only weakly associated with cognitive ability, and

convergent validity, with each factor aligning closely with one of the Big Five traits: conscientiousness, agreeableness, and openness to experience, respectively. Notably, intrapersonal character is especially predictive of academic outcomes such as grades, underscoring the importance of grit and self-control for goal-directed achievement.

2.2 What Grit Isn't

Given the varying degrees of conceptual overlap between industriousness (working hard with purpose and diligence to achieve goals), persistence / perseverance (remaining motivated and resilient in the face of challenges), self-control (controlling impulses to meet valued goals) and grit, it comes as no surprise that significant correlations between conscientiousness and grit in the literature range from .44 to .98 (e.g., Credé et al., 2017; Feng & Rost, 2019; Fleckenstein et al., 2014; Ponnock et al., 2020; Rimfeld et al., 2016; Tucker-Drob et al., 2016). In fact, the difficulty to differentiate grit from conscientiousness and its established facets, both conceptually and empirically, has been the focus of vigorous debate in recent years. One prominent argument is that grit may simply be 'old wine in new bottles', also known as a 'jangle fallacy', which is the erroneous assumption that two measures that are labelled differently (grit and conscientiousness) actually measure different concepts (see Credé, 2018; Credé et al., 2017; Muenks et al., 2017; Ponnock et al., 2020). Empirically, a large-scale meta-analysis carried out by Credé et al. (2017) lends support to this claim, as "the size of the correlation ($\rho = .84$) with overall conscientiousness is so strong ... that grit may be redundant" (p. 502).

Other researchers chose to focus on facets rather than broad traits and found strong relationships between the *perseverance* facet of grit and the *industriousness* / *productiveness* facet of conscientiousness (Lechner et al., 2019; Schmidt et al., 2018)¹⁰, and between grit (particularly grit-PE) and *self-control* (e.g., Credé et al., 2017; Duckworth et al., 2007; Gonzalez et al., 2020; Muenks et al., 2017; Oriol et al., 2017; Vazsonyi et al., 2019; Werner et al., 2019). Duckworth and Gross (2014) have argued that grit and self-control are related but ultimately separable concepts, with self-control being particularly relevant for managing lower-level (immediate) goals in everyday situations in which distractions are common, and grit being fundamental to achieving superordinate (long-term) goals. Additionally, grit's main proponents contend that unlike related facets of conscientiousness, grit "further denotes extreme stamina in terms of particular interests and applied effort toward these interests ... for extremely long stretches of time" (Duckworth & Eskreis-Winkler, 2015, p. 397). Predictably,

¹⁰ cf. Sudina & Plonsky (2021), who only found small to medium correlations between a domain-specific measure of grit and industriousness.

the perseverance of *effort* subscale of grit shares more variance with conscientiousness than the consistency of interests subscale, the latter reflecting commitment to valued interests over long stretches of time (e.g., Schmidt et al., 2018). Section 2.5 will offer an in-depth look at the structure / facets of the grit construct.

Outside the conscientiousness family, grit has moderate to high correlations with (generalized) self-efficacy, which is the global confidence in one's competence to deal successfully with challenges in a broad range of settings (Credé et al., 2017; Oriol et al., 2017; Usher et al., 2019). Self-efficacy, akin to grit, plays an important role in how one approaches difficult tasks and goals. Unlike grit, however, core self-evaluations such as self-efficacy do not include the element of interest / passion or a long-term frame of reference. Rather, they are likely to be psychological resources necessary for sustained passion *and* perseverance because committing to—and fighting for—deeply valued, long-term goals implies believing in one's ability to cope with trials or setbacks and approaching difficult tasks as something to be mastered (Southwick et al., 2019).

Another nomological neighbor of grit that is generally explored outside the Big Five model of personality (but is positively related to extraversion, conscientiousness, and emotional stability, see Oshio et al., 2018, for a review) is psychological resilience. Resilience is a multifaceted construct that includes *traits* that determine someone's capacity to overcome significant adversity, the dynamic *processes* of coping with stressful or traumatic life events, and the *outcomes* of recovering from negative experiences (also known as successful adaptation or adjustment). Both resilience and grit entail surmounting substantial hurdles, but resilience is a *reaction* to external stressors, the elasticity needed to bounce back into shape under adverse conditions. Having grit does not necessarily require a hostile environment or expending effort during a critical life event. More importantly, in resilience (as in psychological hardiness, which is considered an important factor in resilience¹¹), there is no goal attainment (Georgoulas-Sherry & Kelly, 2019). Gritty individuals need resilience in the *proactive* and zealous pursuit of long-term goals; hence, “by definition, resilience is an inherent attribute of grit” (Stoffel & Cain, 2018, p. 125).

2.3 How Grit Relates to Motivation, Cognition, and Behavior

Motivationally, grit is closely tied to the pursuit of meaningful and engaging goals. Individuals high in grit are motivated by attention-absorbing activities that provide *engagement* and by altruistic activities that provide *meaning*, but not by hedonic experiences

¹¹ Hardiness is a positive mindset that allows individuals to adapt, perform, and remain mentally stable under stressful circumstances (see Maddi et al., 2012).

centered on pleasure (Von Culin et al., 2014). Likewise, an others-focused purpose—considering, valuing, and serving others—has been identified as a significant predictor of grit-PE (Sriram et al., 2018). These findings align with evidence that individuals with a strong *sense of purpose* report higher levels of grit (Yukhymenko-Lescroart et al., 2023).

Grit is also positively associated with (academic) *self-efficacy*, *task values*, mastery and performance *goal orientations*, *achievement values*, and *expectancies for success*—particularly grit-PE, which demonstrates stronger ties to these motivational constructs and academic achievement than grit-CI (e.g., Chen et al., 2018; Datu et al., 2017b; Muenks et al., 2017; Renshaw & Bolognino, 2016; Steinmayr et al., 2018; Wolters & Hussain, 2015). Similarly, grit is positively linked to *self-esteem* (e.g., Sharma et al., 2021; Weisskirch, 2018), which mediates the relationship between grit and life satisfaction (J. Li, Fang, et al., 2018).

Relatedness needs satisfaction, the fulfilment of the need for meaningful social connections, is another motivational factor linked to grit. For example, students who feel a stronger sense of relatedness to teachers and parents exhibit higher grit (Datu, 2017). In the context of the COVID-19 pandemic, relatedness needs satisfaction and meaning in life mediated the positive effects of grit on mental health outcomes, such as reduced anxiety and loneliness, and increased happiness (Datu & Fincham, 2022).

Cognitively, grit aligns with attributes that support adaptive responses to challenges. *Optimism*, characterized by the habitual expectation of favorable outcomes, has been positively linked to grit (Agrawal et al., 2022; Clement et al., 2020; Y. S. Kim & Lee, 2021; Oriol et al., 2020; Pyo et al., 2024; Sharma et al., 2021; Tuckwiller et al., 2017). Similarly, an *optimistic explanatory style*—the tendency to view adverse events as specific, temporary, and changeable—fosters resilience and is associated with grit (Duckworth et al., 2009). *Resilience* itself, encompassing cognitive flexibility, effective problem-solving, and positive reappraisal of challenges, strongly correlates with grit (Georgoulas-Sherry & Kelly, 2019). For instance, Kannangara et al. (2018) found that grit was positively tied to resilience and well-being, while inversely related to stress. *Hardiness*, a resilience-related trait, also shows a positive relationship with grit (Lovering et al., 2015). (Dispositional) *mindfulness*, the ability to maintain non-judgmental awareness of present-moment experiences, has also been linked to grit (Aguerre et al., 2022; Christopher et al., 2022; Jarukasemthawee et al., 2021; M. Lee, 2022; Mohammad Hosseini et al., 2023; Raphiphatthana et al., 2018, 2019; Raphiphatthana & Jose, 2020; Vela et al., 2018; Yang et al., 2022). Mindfulness also plays a role in grit's association with subjective well-being. In Chinese adolescents, mindfulness partially mediated the relationship between grit and well-being, suggesting grit may enhance well-

being by fostering mindful awareness (J. Li, Lin, et al., 2018).

A substantial body of (cross-sectional) research has established a strong link between grit and *self-control*, a core aspect of executive functioning, with correlations ranging from .48 to .81 (e.g., Credé et al., 2017; Duckworth et al., 2007; Gonzalez et al., 2020; Kannangara et al., 2018; Muenks et al., 2017; Oriol et al., 2017; Vazsonyi et al., 2019; Werner et al., 2019; Yeager et al., 2014). This capacity to suppress impulsive actions and resist short-term temptations may allow gritty individuals to sustain effort toward achieving their valued goals.

Gritty individuals are also more likely to hold a *growth mindset*, believing that intelligence and abilities can improve with effort (e.g., Duckworth & Eskreis-Winkler, 2013; Fathi et al., 2024; Hochanadel & Finamore, 2015; Kannangara et al., 2018; J. Kim & Park, 2017; Lastner et al., 2022; L. Liu et al., 2023; Tang et al., 2019; Tucker-Drob et al., 2016; S. Wang et al., 2018; West et al., 2016; Yeager, Romero, et al., 2016; Yeager, Walton, et al., 2016; Zeng et al., 2019). Growth mindset encourages individuals to view challenges as opportunities for learning, fostering resilience and adaptability in the face of setbacks. Additional cognitive attributes associated with grit include an *internal locus of control*—the belief that life's outcomes are primarily determined by one's own actions—which fosters a sense of agency and accountability (e.g., Alaoui & Fons-Rosen, 2019; Burgoyne et al., 2018; Meindl et al., 2019; Terry et al., 2024).

Behaviorally, grit is marked by sustained and high-quality effort over time. *Deliberate practice (DP)*—known from work on the development of expert performance (Ericsson et al., 1993) and defined as effortful practice activities meant to improve specific features of performance (Duckworth & Eskreis-Winkler, 2013)—appears to play a key role in this process. For example, DP fully mediated the relationship between grit and performance in competitions (Duckworth, Kirby, et al., 2011), partially mediated the link between grit and skill level among youth soccer players (Larkin et al., 2023), and moderated the relationship between grit and academic achievement among high school students (S. Lee & Sohn, 2013).

Furthermore, gritty individuals tend to invest in learning-related behaviors, enhancing their capacity to achieve long-term goals. For instance, gritty students engage in *self-regulated learning*, proactively adjusting their behaviors and strategies to optimize learning and achieve their goals (Armstrong et al., 2018; Wolters & Hussain, 2015). Additionally, those with higher levels of grit and self-efficacy are more likely to employ effective *cognitive learning strategies* (L. Jiang et al., 2023). Grit also predicts good habits (Feldman & Freitas, 2016), increasing students' ability to manage academic demands. Finally, grit also correlates strongly with *engagement* (e.g., Tang et al., 2019). Datu et al. (2018) found that grit predicted

higher behavioral, cognitive, and emotional engagement among high school students.

2.4 Why Grit Matters

Grit is commonly proposed as orthogonal to cognitive ability (typically measured via proxies such as test scores on high-stakes examinations) and much of the extant research supports this distinction (e.g., Chang, 2014; Credé et al., 2017; Duckworth et al., 2007; Duckworth, Quirk, et al., 2019; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014; Kelly et al., 2014; Zisman & Ganzach, 2021). This important finding indicates that grit could explain variance in achievement above and beyond that explained by intelligence and, consequently, interventions that augment grit may have significant bearing on performance.

In terms of how grit compares to other *non-cognitive* predictors of success, some researchers maintain that grit has little incremental validity over conscientiousness in predicting (e.g., academic) achievement (Credé et al., 2017; Ivcevic & Brackett, 2014; Minnigh et al., 2024; Rimfeld et al., 2016). However, grit-PE has been found to explain “relatively large amounts of unique variance” (Credé et al., 2017, p. 501) in academic achievement even after controlling for conscientiousness.

Since the publication of the seminal work on grit by Duckworth et al. (2007), overall grit—as well as one or both of its facets independently—have been proven to predict multiple success outcomes, particularly in contexts where progress is arduous and quitting is commonplace (Eskreis-Winkler, Gross, et al., 2016). Before going into more detail on grit’s role in education, which is the focus of the present research, it is important to offer a brief overview of the grit-related findings in other contexts, such as work environments, the health sector, the military, teaching, athletics, personal well-being, and healthy aging.

In terms of *career outcomes and work-related functioning*, grit has been linked to fewer career changes (Duckworth et al., 2007; Duckworth & Quinn, 2009); employee retention (Eskreis-Winkler et al., 2014); positive leadership behaviors (Caza & Posner, 2019); as well as better job performance, higher work engagement and affective job commitment, higher income, and greater job satisfaction (Danner et al., 2020; Dugan et al., 2019; Probst et al., 2021; Suzuki et al., 2015). Grit also predicts entrepreneurial success, including venture performance (Mueller et al., 2017), innovativeness (Mooradian et al., 2016), and self-employment, particularly among females and younger individuals (Wolfe & Patel, 2016). Moreover, grit has been associated with greater psychological resilience in the workplace, mitigating the negative effects of burnout on counter-productive workplace behaviors (Ceschi et al., 2016). Grittier individuals are less prone to work stress (Meriac et al., 2015), and more likely to withstand common challenges such as workplace incivility (Kabat-Farr et al., 2019).

In the *healthcare sector*, which faces significant challenges like attrition, turnover, and burnout, grit has emerged as a key factor in mitigating negative outcomes and enhancing retention, performance, and well-being (Underdahl et al., 2018). Higher grit scores have been linked to greater psychological well-being and lower attrition among surgical residents (Salles et al., 2014, 2017; A. Walker et al., 2016), improved job performance, satisfaction, and engagement, as well as lower burnout and turnover intention among nurses (Jeong et al., 2019; X. Liu et al., 2024; Seguin, 2019; Sellers et al., 2019), and reduced burnout among emergency medicine residents and doctors (Dam et al., 2019; Halliday et al., 2017). In the health professions education, grit correlates with better academic and clinical performance, higher engagement, and lower stress and burnout among nursing and pharmacy students, highlighting its importance for both current practitioners and students preparing to enter the field (e.g., Kang & Choi, 2022; Pate et al., 2017; Robinson, 2015; Terry & Peck, 2020).

Grit has also garnered significant attention in the *military sector* since Duckworth et al. (2007) demonstrated its ability to predict cadets' persistence through the rigorous 'Beast Barracks' training in the U.S. Military Academy at West Point. Follow-up studies confirmed grit's predictive power for long-term retention and graduation, outperforming cognitive and physical abilities (Duckworth, Quirk, et al., 2019; Kelly et al., 2014). More importantly, perhaps, higher grit has been associated with fewer suicide attempts, fewer arrests, and less homelessness among veterans (Edwards et al., 2022), as well as fewer depression symptoms among marine recruits (Lovering et al., 2015). Grit also moderated the relationship between hopelessness and suicidal ideation among military personnel, reducing both ideation and preparations for suicide (Pennings et al., 2015). These findings underscore grit's importance for persistence, performance, and psychological resilience in military contexts.

A longitudinal study by Duckworth et al. (2009) on the predictors of teacher effectiveness sparked significant interest in grit's role in the *teaching profession*, showing that grittier teachers produce superior student learning gains. Follow-up research confirmed that grit predicts both teacher effectiveness and retention (Robertson-Kraft & Duckworth, 2014). In India, grit and self-efficacy were top predictors of teacher motivation (Kevin et al., 2020), while in the Philippines, grit was linked to performance and happiness among teachers in studies using a domain-specific grit measure (Teacher Grit Scale) (Baraquia, 2020; Binalagay et al., 2024). As interest in grit shifted to foreign language learning and teaching¹², the L2-

¹² This shift was due in no small part to the introduction of a domain-specific grit scale for second language learners (L2 grit), validated by Teimouri et al. (2022) in the Iranian EFL context. The study was first published online in 2020, hence the L2 grit scale was in use long before the article's journal publication date.

Teacher Grit Scale was developed to assess grit among language teachers in EFL/ESL¹³ contexts. Employing this measure, scholars found that grit strongly predicts retention (Sudina et al., 2021), protects against workplace stressors (Azari Noughabi et al., 2022), enhances work engagement (Liu, Fathi, et al., 2023), fosters teachers' professional identity (Namaziandost et al., 2022), and negatively predicts burnout (Sadoughi et al., 2024).

Given grit's theorized importance in high-stakes situations where quitting carries significant costs, its relevance to *sports research* is unsurprising. Among youth elite soccer players in Australia, grit predicted more practice time and improved skill levels, even after controlling for accumulated practice (Larkin et al., 2023). Similarly, studies on Canadian and U.S. athletes found that grit-PE correlated with practice amount, attendance, and skill, while grit-CI was inversely linked to quitting or switching sports (Tedesqui & Young, 2017, 2018). Grit has also been shown to support high-level athletes during career transitions (Poczwardowski et al., 2014), and to predict higher sport engagement (Martin et al., 2015), superior athletic performance (Ionel et al., 2023), and even success in regaining physical function and activity level after knee surgery (Armento et al., 2023).

Grit is also associated with numerous *personal and health outcomes*. Gritty individuals exhibit more efficient cardiovascular profiles during self-paced mental effort tasks, highlighting autonomic processes that support goal pursuit (Silvia et al., 2013). They also tend to lead healthier lifestyles, being more physically active, less sedentary, and more likely to practice healthful dietary habits, even during a global pandemic (Totossy De Zepetnek et al., 2021). Grit also mediates the relationship between procrastination and physical activity, reducing procrastination tendencies (Tao et al., 2022). Among students, grit correlates with better health-related quality of life, improved diet, and greater food security (Sullivan et al., 2021). Distinct dimensions of grit play unique roles: grit-PE is associated with various physical activities (Daniels et al., 2023), while grit-CI is linked to lower bulimia and body dissatisfaction, protecting against disordered eating (Knauff et al., 2019). Among individuals with disabilities, grit-CI positively influences quality of life (Jang et al., 2023).

Grit also benefits *interpersonal functioning* at various life stages. Gritty individuals report higher levels of attachment behaviors and lower post-traumatic stress symptoms, buffering against the effects of trauma on relational well-being (Witting et al., 2023). Grit is also positively associated with both self and other forgiveness, a quality that fosters healthier relationships (C. O. Walker, 2017). In adolescence, grit is positively linked to peer popularity

¹³ English as a foreign language / English as a second language

(Lan, 2020), stressing its role in building social bonds. Among adults, grit predicts relational stability, with grittier men more likely to stay married (Eskreis-Winkler et al., 2014).

Finally, grit appears to play an important role in *healthy aging*. Older individuals generally report higher levels of grit, potentially due to accumulated life experience (Credé et al., 2017; Duckworth et al., 2007). Age and work experience are positively correlated with increased levels of grit over time (Camp et al., 2019), though Lechner et al. (2019) found that this relationship is curvilinear, varying across sociodemographic segments. Perseverance of effort contributes to successful aging (Y. J. Kim & Lee, 2015), while longitudinal research highlights grit's protective role in late-life cognition. Specifically, adolescent grit predicts better memory performance in old age, surpassing the predictive power of IQ (E. Rhodes et al., 2017). Together, these findings suggest that grit not only supports goal-directed effort but also fosters healthier, more fulfilling lives and relationships across the lifespan.

2.4.1 Grit's Role in Education

The literature on grit in education highlights its importance as a predictor of success across various metrics, such as academic performance (e.g., course grades, standardized test scores, GPA), academic productivity and engagement, retention rates, and overall educational attainment. Grit has also been shown to buffer against negative experiences in educational settings, including anxiety, stress, and depression. These studies underscore the complex interaction of individual, motivational, and contextual factors that influence grit's impact on educational outcomes. Because grit is believed to help reduce college attrition, and because university students are more accessible as research participants compared to school-aged students, the majority of studies on grit and academic achievement are conducted among university students. However, a growing body of research also examines grit in school settings, with the largest number of studies focusing on high school students. Grit research is particularly prevalent in the U.S. and has expanded internationally, with higher concentrations of studies in certain Asian countries (China, South Korea, Indonesia, the Philippines, Taiwan, Hong Kong), Australia, Mexico, and several European countries (Turkey, Finland, Germany, Spain, Switzerland), though it is not limited to these areas.

Grit in Primary Education. In primary education, grit contributes meaningfully to both academic success and socio-emotional development. Studies demonstrate that grit—especially grit-PE—is positively linked with overall academic achievement and improved performance in subjects like math, reading, science, and language arts (W. Jiang et al., 2019; Kaya & Karakoc, 2022; H. J. Lim et al., 2023; Sturman & Zappala-Piemme, 2017; Temel et al., 2023). Additionally, grit supports increased motivation for reading and writing (Bozgün &

Akın-Kösterelioğlu, 2021). For disadvantaged groups, such as Latino English language learners in the U.S., grit-PE predicts later literacy achievement above and beyond emotional engagement (O’Neal et al., 2018) and supports higher performance in language arts, especially when students feel supported by their teachers (Banse & Palacios, 2018). In children with low working memory, grit is linked to long-term improvement, suggesting that it helps sustain persistence in areas of cognitive weakness (Spencer-Smith et al., 2023). Grit also works in tandem with self-control and resilience to reduce anxiety and depression and enhance academic performance and quality of life, particularly for students with reading disorders (Hossain et al., 2022). Finally, grit was also shown to enhance cognitive, social, and behavioral engagement and promote positive emotions (Datu, Buenconsejo, et al., 2023).

Grit in Secondary Education. Multiple studies have found that grittier middle and high school students reach higher levels of academic achievement, as evidenced by course-specific academic performance, higher GPAs, greater academic engagement (including attendance and good behavior), academic motivation, and retention (e.g., Clark & Malecki, 2019; Cosgrove et al., 2018; Datu et al., 2016, 2018; Duckworth & Quinn, 2009; Dumfart & Neubauer, 2016; Eskreis-Winkler et al., 2014; Fisher, 2020; Hagger & Hamilton, 2019; Hatchimonji et al., 2022; Holbein et al., 2020; B. K. Jones et al., 2018; Karlen et al., 2018; J. Li, Zhao, et al., 2018; Morell et al., 2021; D. Park et al., 2018; Piña-Watson et al., 2015; Postigo et al., 2020; Schmidt et al., 2019; West et al., 2016). Furthermore, grit was found to have a strong negative correlation with procrastination, which is a major form of academic self-handicapping (Schmidt et al., 2019). In specific subjects, such as science, grit-PE and self-discipline enhance effort on optional out-of-school science activities that are linked to better grades (Hagger & Hamilton, 2019). Research also shows that grit-PE has a stronger influence on various academic outcomes than grit-CI (e.g., Datu et al., 2024; Muenks et al., 2017, 2018; Peña & Duckworth, 2018; Steinmayr et al., 2018).

Grit also seems particularly beneficial for students from disadvantaged backgrounds. Huang and Zhu (2017) found that low-SES students who reported higher levels of grit outperformed their peers in mathematics and science, suggesting that grit can help bridge achievement gaps associated with socioeconomic disadvantage. Among underserved populations, such as Latinx adolescents in certain U.S. regions, grit—along with lower absenteeism—has been associated with higher Advanced Placement exam performance, and grit-PE has been found to predict end-of-year grades beyond prior academic achievement (Cosgrove et al., 2018; Hatchimonji et al., 2022). For migrant students, grit also correlates with improved educational outcomes (Tovar-García, 2017).

Beyond academic achievements, grit supports students' broader psychological and social development. Grit is positively associated with life satisfaction, school satisfaction, peer relationships, and meaning in life, fostering overall well-being (Clark & Malecki, 2019; Datu et al., 2019; D. Park et al., 2017). During the COVID-19 pandemic, perseverance was shown to support students' life satisfaction and post-traumatic growth, helping them to view adversity as an opportunity for growth (Casali et al., 2023). Additionally, grit mitigates the negative effects of adverse experiences; for example, it lessens the impact of bullying on depression among left-behind adolescents (Gao et al., 2023) and acts as a protective factor against substance use and delinquent behavior among at-risk Latino high school students (Guerrero et al., 2016). Furthermore, grit supports civic and school engagement, as gritty students are more likely to participate in class, volunteer, and intend to vote when eligible, illustrating its role in shaping responsible, goal-oriented behaviors (Holbein et al., 2020).

Grit in Tertiary Education. Grit continues to be a valuable asset for young adults navigating the demands of higher education. However, two recent meta-analyses show that it has a somewhat lower impact on achievement among university students than among secondary students (Lam & Zhou, 2019, 2022). Still, grit—particularly its perseverance facet—is positively associated with key academic outcomes for university students, including college grades, GPA, college satisfaction, (co)-curricular engagement, adjustment, sense of belonging, and faculty-student interaction (e.g., Akos et al., 2022; Aparicio et al., 2017; Bowman et al., 2015; Chang, 2014; Cross, 2014; Datu et al., 2016; Duckworth et al., 2007; Hodge et al., 2018; W. W. S. Lee, 2017; Muenks et al., 2017; Owusu et al., 2020; Reysen et al., 2019; Strayhorn, 2014; Wolters & Hussain, 2015). Grit-CI, although less predictive of academic performance (with several exceptions, e.g., Chen & Gong, 2021), contributes meaningfully to well-being and quality of student life. For instance, higher consistency has been linked to greater life satisfaction and positive affect (Chen & Gong, 2021), a lower likelihood of changing majors (Akos & Kretchmar, 2017; Bowman et al., 2015), reduced performance-avoidance goals (Chen et al., 2018), less procrastination (Pierro et al., 2011; Wolters & Hussain, 2015), fewer academic problems (Kalia, 2021), and lower levels of stress, anxiety, and depression (Kalia, 2021; W. W. S. Lee, 2017; M. Zhang et al., 2018).

Grit also plays an important role in student retention and graduation rates (e.g., Caporale-Berkowitz et al., 2022; Duckworth et al., 2007; Duckworth, Quirk, et al., 2019; Duckworth & Quinn, 2009; Kebritchi et al., 2023; Kelly et al., 2014; Saunders-Scott et al., 2018; Slick & Lee, 2014). Moreover, it appears to be beneficial for university students from disadvantaged backgrounds. For instance, first-generation college students with high levels of

grit are more likely to persist and succeed in higher education (Hodge et al., 2018). Grit-PE can also have compensatory effects that help historically underrepresented students (female, non-white, first-generation) overcome challenges (Fosnacht & Webb-Copridge, 2021).

Beyond academic performance, grit has significant implications for college students' psychological well-being (Kannangara et al., 2018; Vainio & Daukantaitė, 2016). Research links grit with factors such as hope, meaning in life, and gratitude (Clement et al., 2020; Kleiman et al., 2013; Kumar & Sarita, 2022; Vela et al., 2015; M. Zhang et al., 2018). During the COVID-19 pandemic, grit was associated with greater resilience and lower levels of psychological distress among college students (Bono et al., 2020), proving its protective role in times of significant stress. Grit is negatively associated with burnout, anxiety, depression, hopelessness, and suicidal ideation (Blalock et al., 2015; Clement et al., 2020; Kleiman et al., 2013; Musumari et al., 2018; Tang et al., 2021; E. J. White et al., 2017). Grittier students are also less likely to engage in problematic behaviors such as gambling, compulsive internet use, or compulsive buying (Maddi et al., 2013). These findings suggest that grit may mitigate mental health challenges prevalent in high-pressure tertiary education settings.

Limitations and Considerations. Although grit shows significant associations with various academic outcomes, its predictive strength is often context-dependent and sometimes more modest than that of other traits. For instance, Dixson (2021) found that academic self-concept explained more variance in high school GPA than grit, whereas Zisman and Ganzach (2021) reported minimal effects of grit on high school GPA and degree attainment beyond intelligence and conscientiousness in a representative U.S. sample. Yet, a meta-analysis by Lam and Zhou (2022) concluded that grit's impact on academic outcomes is comparable to that of other non-cognitive traits, such as emotional intelligence and conscientiousness. Grit's context-specific importance is highlighted, for example, in a decade-long study of over 10,000 military cadets, where it modestly predicted academic performance but outperformed cognitive ability in predicting graduation and emerged as the only reliable predictor of completing initial training (Duckworth, Quirk, et al., 2019). These findings suggest that grit may play a critical role within selective, homogenous groups or in high-endurance environments where persistence through adversity is crucial (Zisman & Ganzach, 2021).

Conclusion. Grit plays a multifaceted role in education, supporting academic achievement and well-being across diverse contexts and age groups. In secondary and higher education, grit enhances performance, retention, engagement, and attainment, with grit-PE strongly linked to academic success and grit-CI serving as a buffer against maladaptive outcomes. Students from disadvantaged backgrounds benefit significantly from grit, which

helps bridge achievement gaps and build resilience. While grit's predictive power is often context-dependent, its impact is amplified in supportive environments and through synergies with attributes such as growth mindset, self-control, and self-efficacy.

These findings have contributed to grit becoming a buzzword among education policymakers in the U.S. and the U.K., who have emphasized “promoting grit, tenacity, and perseverance” (SRI International, 2018, p. 7) and “teaching character, resilience, and grit to pupils” (Department for Education, 2014, para. 1). These factors are also included in prominent policy documents such as the U.S. Common Core State Standards for Mathematics, which designate perseverance as a key mathematical practice, and the U.S. National Research Council's report on 21st-century competencies, which identifies grit as essential for fostering skills needed in modern education and the workforce (SRI International, 2018). In Germany, the Vodafone Stiftung has funded research on closing the socioeconomic achievement gap through scientifically sound, cost-effective psychological and behavioral interventions at the school level (Spencer et al., 2014). This growing interest reflects the potential that social-psychological interventions, including those on grit, hold for boosting academic performance.

2.5 How Grit Is Operationalized and Measured

The factorial structure of grit has been a topic of ongoing debate. Duckworth et al. (2007) proposed a hierarchical structure with two first-order factors and developed the 12-item Grit-O scale to assess the consistency and perseverance dimensions. Addressing concerns about length and item performance, they later validated an 8-item version (Grit-S) that retains the two-factor structure with four items per subscale (Duckworth & Quinn, 2009). While Grit-S has become the most widely used measure due to its brevity and satisfactory psychometric performance in many contexts, both scales and the hierarchical model have faced substantial criticism on both conceptual and methodological grounds.

2.5.1 Conceptual Issues

The Grit-S scale omits items that highlight grit's long-term nature—such as ‘I have achieved a goal that took years of work’—limiting its ability to capture the time-relevant aspects that are supposed to differentiate it from self-control, conscientiousness, or self-efficacy (Tynan, 2021). These omissions appear to alter grit's internal structure, as evidenced by a substantially stronger correlation between perseverance and consistency in the Grit-S scale ($\rho = .66$) compared to the Grit-O ($\rho = .27$; Credé et al., 2017).

Another conceptual issue lies in the use of the term ‘passion’ to describe the grit-CI component. Critics argue that grit-CI does not measure passion, understood as a “strong feeling toward a personally important value or preference” (Jachimowicz et al., 2019, p.

3942)¹⁴. Instead, its items assess *stability* of interests (e.g., ‘I often set a goal but later choose to pursue a different one’), independent of whether these are meaningful or deeply held goals. Supporting this critique, Grohman et al. (2017) found no significant relationship between grit-CI scores and teacher-rated passion, suggesting that the lay understanding of passion differs from how it is operationalized within the construct of grit.

2.5.2 Measurement Issues

A major concern involves the confounding of item wording with subscale assessment: perseverance items are positively phrased, while consistency items are negatively phrased. This design choice can artificially create two distinct factors, compromise the psychometric integrity of the scales, and suppress the predictive utility of grit-CI (Credé, 2018; Jachimowicz et al., 2019; Vazsonyi et al., 2019). Meta-analytic findings partly corroborate these concerns, showing that grit-PE consistently outperforms grit-CI and overall grit in predicting performance (Credé et al., 2017). However, Rocha and Lenz (2023) noted that while grit-PE is the more significant contributor to grit, it often has lower internal consistency than grit-CI, complicating interpretations of these subscales’ reliability.

With regard to grit’s factorial structure, critics have (correctly) argued that a hierarchical model with only two first-order factors is mathematically indistinguishable from a nonhierarchical model with two correlated factors, casting doubt on whether grit functions as a unified construct (Credé et al., 2017; M. Li et al., 2023). Additionally, the correlation between grit-PE and grit-CI varies widely across studies, failing to offer conclusive support for a latent grit construct (Credé et al., 2017; Datu, 2021; Guo et al., 2019).

Most studies—and most validations of grit scales outside the U.S.—verify the existence of two distinct grit components, with occasional support for the originally proposed hierarchical model (e.g., Jachimowicz et al., 2018; Schmidt et al., 2019, 2021). However, alternative dimensional structures have been proposed, including unidimensional models (e.g., Areepattamannil & Khine, 2018; Gonzalez et al., 2020; Jachimowicz et al., 2019), two correlated factors (e.g., Guo et al., 2019; Midkiff et al., 2017; Muenks et al., 2017; Tyumeneva et al., 2019)¹⁵, and bifactor models (e.g., Disabato et al., 2019; M. Li et al., 2023;

¹⁴ For an entirely different view of grit-CI, cf. Abuhassan and Bates (2015), who argue that consistency of interests is better understood as a facet of conscientiousness, hence “what is unique to Grit ... is a single (rather than bi-factor) construct tapping effortful persistence or ‘elbow grease’” (p. 212).

¹⁵ Alaoui and Fons-Rosen (2019) proposed an alternative two-factor model that reclassifies grit into Diligence—a positive skill—and Tenacity, which combines the positive trait of perseverance with the negative trait of stubbornness. This model uses the same items as those measuring perseverance and consistency but organizes them differently from the standard categorization.

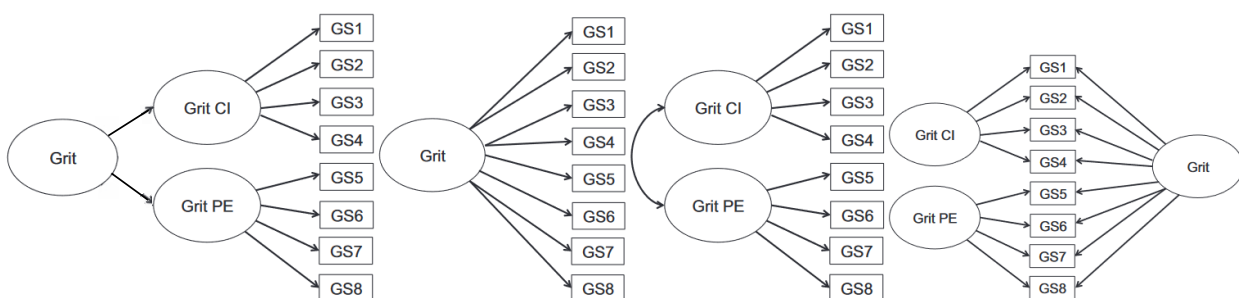
Muenks et al., 2017; Van Zyl et al., 2022)¹⁶. These models are depicted in Figure 2.1 (below).

Duckworth et al. (2021) acknowledged the limitations of fitting higher-order models with only two lower-order factors, noting that standard factor analysis cannot resolve theoretical debates about grit's structure. Nonetheless, they argue that grit is best understood as a compound of two distinct but related orientations toward long-term goals, and emphasize that grit's predictive validity remains robust regardless of how it is scored—whether as a unidimensional factor, averaged subscales, a hierarchical model, or a bifactor model—with correlations between scoring approaches ranging from .91 to .99 for both Grit-O and Grit-S.

Bifactor models have recently demonstrated superior fit in both U.S. and cross-cultural samples (Disabato et al., 2019; M. Li et al., 2023; Morell et al., 2021; Van Zyl et al., 2022). However, cultural variability complicates the interpretation of grit's structure. For example, grit-CI items often perform poorly in non-Western, collectivistic contexts, as seen in Filipino (Datu et al., 2016), Japanese (Nishikawa et al., 2015), Chinese (M. Li et al., 2023), and Romanian samples (Ion et al., 2017). These findings suggest that grit-CI's emphasis on maintaining consistent interests aligns less with collectivistic values. To address cultural limitations, Datu et al. (2017a) proposed the Triarchic Model of Grit Scale (TMGS), which adds a third dimension—adaptability to situations—to reflect the flexibility and resilience valued in collectivistic cultures. This three-factorial model has shown strong reliability and validity across multiple studies (Datu, Buenconsejo, et al., 2023; Datu et al., 2017a, 2018, 2024; Datu, Fong, et al., 2023; Datu, McInerney, et al., 2021; Datu, Yang, et al., 2021).

Figure 2.1

Graphical Representations of Grit Structural Models



Note. Adapted from Muenks et al. (2017). From left to right: hierarchical model, unidimensional model, two correlated factors model, bifactor model. CI = consistency of interests; PE = perseverance of effort.

¹⁶ In bifactor models, a general grit factor accounts for shared variance across all items, while specific factors capture unique variance for grit-PE and grit-CI. Notably, bifactor models also allow researchers to evaluate the unique predictive utility of grit-PE and grit-CI, addressing critiques about their unequal contributions to grit's overall predictive validity.

While debates over grit's factorial structure continue, researchers are increasingly analyzing perseverance and consistency as related yet distinct constructs rather than combining them into an overall grit score. The current study shifts focus from grit's dimensions to its *psychological antecedents*—the beliefs and skills that enable individuals to exhibit grit—providing a fresh perspective on understanding and cultivating this attribute.

2.5.3 Alternative Measures of Grit

To address critiques of existing grit scales, researchers have developed alternative instruments that refine the construct or adapt it to specific cultural and professional contexts. Alongside the TMGS mentioned above, the most widely used alternatives include the L2-Grit Scale for language learners (Teimouri et al., 2022), the L2-Teacher Grit Scale for language teachers (Sudina et al., 2021), and the Academic Grit Scale by Clark and Malecki (2019). Similar to the TMGS, which introduced adaptability as a third dimension, the 3-D Grit Scale (Kuruveettissery et al., 2023) and the Multi-Dimensional Scale of Grit (Singh & Chukkali, 2021) in India, as well as the Grit Scale in Turkey (Kardaş et al., 2022) added dimensions like goal-directed resilience, adaptability to situations, spirited initiative, steadfastness in adverse situations, and commitment to goals. These scales aim to address the limitations of existing measures by broadening the construct to include culturally relevant values.

Other adaptations have sought to tailor grit measurements to specific populations or purposes. The unidimensional Oviedo Grit Scale (EGO) was developed to assess grit in Spanish-speaking populations (Postigo, Cuesta, García-Cueto, et al., 2021), while an Arabic version of this scale was validated in Lebanon (Fekih-Romdhane et al., 2022). Educational contexts have seen a proliferation of grit scales, including the Character Growth Card, used by the KIPP network of charter schools (CharacterLab, 2011), the Academic Grit Scale for Middle School Students (AGQMS, Lin et al., 2024), which measures clear goals, continuous effort, and positive beliefs, the LT-Grit Scale (Morell et al., 2021), emphasizing grit's long-term nature, the Grit Scale for Children and Adults (GSCA, Sturman & Zappala-Piemme, 2017), designed for broad age-range applicability, and the Teacher Grit Scale (TGS, Baraquia, 2020), measuring perseverance in teaching. An example of a profession-specific instrument is the Clinical Nurses Grit Scale (CN-Grit) developed in Korea, which measures persistence, professional consistency, and patient-oriented intrinsic motivation (H. Park et al., 2020).

Distinct from these efforts, Schimschal et al. (2022, 2023) developed the Grit Psychological Resources Scale (GPRS), which does not measure grit directly but assesses psychological resources that support grit—namely Interest, Purpose, Practice, and Hope, derived from Duckworth's conceptual framework (2016).

Grit measures have also emerged outside traditional academic settings. The GRIT Gauge™ 3.0, developed by Stoltz and PEAK Learning, is a commercial product designed to assess grit across four dimensions: **G**rowth, **R**esilience, **I**nstinct, and **T**enacity. This 32-item digital assessment is available for purchase by companies and institutions (Grant, 2018).

Together, these alternative measures illustrate the dynamic evolution of grit as a construct. By expanding its dimensions, refining its focus, and adapting it to specific cultural and contextual demands, these tools enhance grit's applicability across diverse settings.

2.6 Whether Grit Can Be Trained

Duckworth et al. (2007) consider grit to be a relatively stable personality trait, the level of which increases somewhat with age. This does not mean, however, that it is immutable. Duckworth and Yeager (2015) offer a useful characterization of all non-cognitive attributes—including grit—as (a) fairly stable over time *in the absence of external factors* such as willful interference or major events, (b) reliant on circumstance for their expression, and (c) possibly susceptible to intervention.

Researchers and educators have tested the efficacy of non-cognitive skills interventions both within and beyond the classroom, particularly given their potential to support underperforming or socioeconomically disadvantaged students. These interventions often target constructs *related to grit* but studied independently of it, such as mindsets, resilience, expectancies, values, self-transcendent purposes for learning, social belonging beliefs, goal-setting, deliberate practice, motivation, self-control, and metacognitive skills (see Black & Allen, 2020; Durlak et al., 2011; Dweck et al., 2014; Kautz et al., 2014; Levin, 2015; Morrison Gutman & Schoon, 2013; Snipes et al., 2012; SRI International, 2018; Zhou, 2016).

A detailed, though non-exhaustive, literature search up to 2024 identified 33 studies examining the impact of programs, courses, or interventions on grit or gritty behavior, only 12 of which—six peer-reviewed articles, one report, and five unpublished theses—were available prior to the implementation of the grit interventions in the present doctoral project. In these studies, grit was assessed as either the primary outcome or a secondary outcome (e.g., evaluating the effects of a growth mindset intervention on growth mindset and grit).

Programs and interventions assessed for their impact on grit are highly diverse, ranging from single-session mindset interventions to year-long educational programs, and employing tools like school curricula, mindfulness or happiness training, fitness programs, mentoring, goal-setting exercises, functional imagery training, weight management initiatives, therapeutic approaches, and even social action projects and citizenship education. Sample sizes also vary widely, from as few as three participants (Sari et al., 2022) to a nation-wide

sample of ca. 33,000 middle school students across 350 schools (Santos et al., 2021).

Eskreis-Winkler's (2015) doctoral research, parts of which were later published as Eskreis-Winkler, Shulman, et al. (2016), spanned ten placebo-controlled, double-blind interventions and found that grit can be cultivated through deliberate practice (DP) and grit mentoring, with short-term improvements in academic performance, motivation, effort, DP behaviors, and goal commitment across diverse samples, including students, smokers, and job seekers.

Several studies have implemented structured, curriculum-based programs in U.S. school settings to enhance grit and related non-cognitive skills. For example, Carrier Lyon (2014) introduced lessons on optimism, self-control, and perseverance to 85 students over one school year, showing significant gains in grit scores in the experimental group. Similarly, a New York middle school implemented a curriculum focusing on growth mindset, resilience, and personal control, increasing internal locus of control and grit, both of which predicted standardized test achievements (Zappala-Piemme et al., 2023). Orji (2020) reported significant increases in grit in the intervention group following a six-week grit curriculum for Chicago high school freshmen. Meanwhile, a Navajo values-based six-week curriculum for pre-adolescent Native American students yielded gains in self-efficacy, growth mindset, and grit-related language, though not on the grit measure itself, highlighting both the promise and challenges of culturally adapted grit curricula (Hoskie, 2023).

Outside the U.S., both small and large-scale interventions have shown the adaptability and effectiveness of grit-focused programs. In North Macedonia, a five-week nationwide intervention targeting grit and self-regulation in middle school students included DP exercises and sustained effort motivation, resulting in increased grit-PE and improvements in academic performance, especially for disadvantaged students (Santos et al., 2021). In Turkey, a program for 4th-graders across 52 public schools combined perseverance, growth mindset, and goal-setting activities, resulting in improved challenge-seeking behaviors and significant gains in mathematics test scores across two independent samples, with math scores remaining elevated even two years post-intervention (Alan et al., 2019). In Pakistan, a 12-week intervention for first-year medical students included sessions on self-regulation, growth mindset, and mindfulness, leading to grit increases for initially low-grit students (Mirza et al., 2021). In Iran, a three-week program for middle schoolers targeted grit and mental toughness, with significant improvements in both (Mohammadi et al., 2023). Meanwhile, a happiness training program for high school students, integrating positive and Islamic psychology themes, led to increases in grit, hope, resilience, and self-control, along with reduced procrastination, with

effects maintained at follow-up (Firoozmokhtar et al., 2023).

Short, single-session interventions have also shown promise in enhancing grit. A 35-minute online intervention in Norway emphasizing growth mindset, grit, and DP significantly enhanced grit among university students (Sigmundsson & Hauge, 2023). In a separate brief intervention, 9th-graders who included competence-building themes in narratives about successes and failures showed increased grit, which mediated improvements in academic achievement (B. K. Jones et al., 2018). DiMenichi and Richmond (2015) found that adults who reflected on past failures in a 10-minute online writing task showed higher grit scores and performed better on a cognitive task requiring perseverance than those who reflected on successes, highlighting grit's experimental malleability and suggesting that failure reflection may result in improved behavioral outcomes. However, not all brief interventions produced clear gains in grit. For example, an online growth mindset activity improved scores on a self-determination factor that included grit, but did not directly boost grit (Burgoyne et al., 2018).

Another group of studies explored the effects of mindfulness- and imagery-based interventions on grit. Among elite female athletes in Iran, a Mindfulness-Acceptance-Commitment program significantly increased grit, mindfulness, and self-compassion, with gains sustained four weeks post-intervention (Mohebi et al., 2021). A mindfulness-based cognitive therapy intervention conducted in Indonesia with university students low in grit led to notable increases in academic grit, suggesting that mindfulness may enhance students' engagement with academic goals (Rusadi et al., 2023). In the UK, Functional Imagery Training (FIT) strengthened grit among professional soccer players by enhancing imagery vividness and goal-setting skills, indicating that visualizing success can foster perseverance in sports (J. Rhodes et al., 2018). Conversely, a Psychological Skills Training (PST) program using mental imagery and self-talk with college basketball players in India received positive feedback yet showed no gains in grit or resilience (Vaishnavi D & Rose, 2023).

Beyond these studies, the Citizenship Foundation and Envision programs in the U.K., while not directly targeting grit, fostered social responsibility and empowerment through hands-on social action projects, significantly boosting grit, empathy, cooperation, a sense of community, and attitudes to education (Kirkman et al., 2016). The OneGoal Program—a low-cost, three-year high school intervention implemented by 98 U.S. schools in low-income communities—includes a socio-emotional skills curriculum focusing on agency, persistence, resilience, growth mindset, goal-setting, and social belonging, and has increased academic performance, high school graduation rates, and college enrollment and graduation rates, while reducing arrest rates among males, with non-cognitive skill improvements accounting for up

to 32% of the overall treatment effects (Hallberg et al., 2022; Kautz & Zanoni, 2024).

In terms of scale and focus on promoting and assessing character strengths, the most comprehensive initiative in a school setting is likely the KIPP Character Strengths framework, implemented by the Knowledge is Power Program (KIPP), a network of 278 public charter K-12¹⁷ schools in the U.S. The KIPP Character Growth Card helps teachers and students track progress on seven key character strengths: grit, hope/optimism, self-control (academic / interpersonal), gratitude, social intelligence, curiosity, and zest¹⁸ (CharacterLab, 2011). This approach has shown promising results: attending KIPP after a middle school lottery increased college enrollment rates by 12.9%, nearly enough to close the nationwide racial disparity in enrollment (Coen et al., 2019). A follow-up study revealed that students who attended KIPP for both middle and high school were nearly twice as likely to graduate from college compared to peers who did not attend KIPP (Demers et al., 2023).

Evaluating the current research on grit interventions reveals both promise and notable limitations. Structured, multi-session programs embedded in school curricula demonstrate benefits for enhancing grit, particularly when they incorporate growth mindset and self-regulation components. Well-designed short interventions, specifically ‘wise interventions’ (explored further in section 3.4), also show promising effects on grit. However, differences in intervention duration, sample sizes, follow-up periods, and the variety of grit measurements complicate cross-study comparisons. Self-report tools like the Grit-S or GSCA, observer-report measures such as the Character Growth Card, and behavioral proxies all capture distinct aspects of grit, contributing to inconsistent findings. Moving forward, grit research would benefit from standardized measurement tools, randomized controlled trials, and larger, more diverse samples to identify the most effective and lasting grit-building approaches.

2.7 What the Grit Critics Say

Criticism of grit generally falls into four categories: studies highlighting grit’s potential contribution to maladaptive outcomes (the so-called ‘dark’ side of grit); research questioning the moral legitimacy of promoting grit, especially in educational settings; studies that argue grit’s usefulness is limited compared to other well-established predictors of achievement (see section 2.4); and critiques of how grit is operationalized and measured (see section 2.5). Here, I will focus on the first two types of criticism.

¹⁷ i.e., from kindergarten to Grade 12.

¹⁸ The KIPP character growth card was developed with input from teachers and psychologists Martin Seligman, Christopher Peterson, and Angela Duckworth, and is intended to foster meaningful discussions about character among students, parents, and teachers. While it is unclear whether the KIPP network still uses the card as of 2024, ‘Focus on Character’ (emphasizing the social and emotional skills essential for student success and well-being) remains a core pillar of KIPP’s approach. For more details, see <https://www.kipp.org/approach/>.

2.7.1 The ‘Dark’ Side of Grit

Some critics highlight the potential ‘dark’ side of grit, particularly when it is not balanced by other virtues like empathy, judgment, or temperance (Eskreis-Winkler, Gross, et al., 2016). For instance, among adults in Indonesia, high grit levels were associated with Machiavellian traits¹⁹ and materialism, indicating that a sole focus on grit may foster success-driven individuals who disregard ethical values. This highlights the importance of integrating ethics into grit development to prevent a ‘success at all costs’ mindset (Arli et al., 2021)²⁰.

A small body of research suggests that, *in specific contexts*, grit can sometimes impair performance or well-being. Among salespeople, for example, a high need for power reduced the positive effect of grit-PE on job performance, implying that grit may not benefit everyone equally (Dugan et al., 2019). Grit-PE has also been linked to perfectionism, potentially causing individuals to impose unrealistic standards on themselves and others (Houston et al., 2021). High grit under low-constraint conditions (where problems have multiple solutions) was associated with cognitive inflexibility, as seen in attempts to solve tasks like Sudoku (Kalia et al., 2019). For music students at risk of study addiction, grit-PE became maladaptive (Czerwiński et al., 2023). High grit-CI can deter individuals from seeking help, as seen in reduced mental health help-seeking among student veterans (Wilson et al., 2023). Moreover, grit can have negative implications when applied to destructive goals. Among students with a history of self-harm, higher grit was linked to more frequent suicide attempts, possibly due to the ability to persist through distressing experiences (Anestis & Selby, 2015)²¹.

Some studies suggest that moderate *levels of grit* are optimal in certain contexts. In the workplace, individuals with moderate grit showed the greatest progress on work goals, with high organizational support mitigating the adverse effects of excessive grit (Khan et al., 2021). Similarly, among adults in the U.S., moderate levels of goal persistence correlated with greater socioeconomic gains (Kwon & Erola, 2023). Excessive grit-PE, by contrast, can make it difficult to abandon futile efforts or goals, ultimately risking performance or financial losses (Alaoui & Fons-Rosen, 2019; Lucas et al., 2015; J. A. Park et al., 2022). This illustrates the ‘too-much-of-a-good-thing’ (TMGT) phenomenon, where the benefits of a resource may diminish at higher levels (Eskreis-Winkler, Gross, et al., 2016; Khan et al., 2021).

In the school context, however, grit interventions are expected to benefit all students, regardless of their initial grit levels, because academic success rarely depends on abandoning

¹⁹ i.e., amorality, desire for control and status, distrust

²⁰ cf. Houston et al. (2021) for a study in which grit was *negatively* correlated with Machiavellianism, hyper-competitiveness, and most forms of narcissism.

²¹ These results are based on a subsample of 37 students (out of 604) with a history of prior suicide attempts.

ventures quickly or pursuing goals unscrupulously, as may occur in business settings. Unlike adults facing high-stakes consequences, students operate within structured environments where teachers, curricula, and the school community guide them on when to persevere and when to reassess goals. Since grit in school is not about pursuing a single, long-term objective, the risks of TMGT—such as stubbornness or cognitive rigidity—are less likely to surface. In this setting, grit supports resilience and skill mastery, with failure framed as a learning opportunity rather than a setback. Furthermore, if grit were eventually integrated into social and emotional learning (SEL) programs, like the Lions-Quest initiative in Germany, which builds ‘life competencies’²², it would develop alongside emotional intelligence, social awareness, and decision-making skills, ensuring its constructive and flexible application.

2.7.2 The Moral Legitimacy of Grit

Not long after grit research gained traction, it was promoted as a pathway for (disadvantaged) students to achieve upward mobility through discipline and perseverance²³. This approach drew criticism for shifting responsibility onto individuals, reinforcing harmful social structures, and enabling school reformers to overlook systemic barriers and disregard material solutions essential for student success (R. M. Cohen, 2015; Kundu, 2014). Critics also argue this view aligns with neoliberal ideals, reinforcing the myth of meritocracy rooted in social class and white privilege and perpetuating a ‘pull yourself up by your bootstraps’ mentality (Gonzalez Stokas, 2015; Gorski, 2016; Saltman, 2014; Schreiner, 2017)²⁴.

Grit ideology is seen by critics as an extension of *deficit ideology*, which attributes issues like lacking family involvement in the child’s education to deficiencies within individuals or communities experiencing poverty, such as laziness or not valuing education. (Gorski, 2016). Grit pedagogy, they contend, is misguided, ignoring the fact that many disadvantaged students are already gritty and resilient and “grasping for amoral solutions to inequity and injustice, which are moral problems” (Gorski, 2016, p. 382).

The appeal of practical solutions like fostering grit in schools is strong, especially since educators alone cannot address structural injustices. However, in the U.S. context where grit originated, some argue that such “quick fixes pathologize African-American children and are inherently anti-Black” (Love, 2019, para. 1), contributing to “an educational culture that reinforces victim blaming [and] reifies inequities for Black and Latinx students with

²² For more information about the Lions-Quest program, visit <https://www.lions-quest.de/>

²³ In *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character* (2012), New York Times journalist Paul Tough presents grit as a new, apolitical, and amoral form of character education, arguing that such character strengths “seem to make a big difference in the academic success of children, especially low-income children” (Tough, 2016, para. 3).

²⁴ In the case of the U.S., this mentality is deeply rooted in the so-called ‘American Dream’ (Schreiner, 2017).

dis/abilities” (Tefera et al., 2019, p. 2). Instead of asking students to be grittier, these authors advocate for holding schools and governments accountable for systemic inequalities in funding, as well as biased policies and instructional practices (Audley & Donaldson, 2022).

Others claim that the grit discourse reflects middle- and upper-class anxieties about children’s character rather than genuine concern for disadvantaged students (Ris, 2015). A few studies support this perspective, showing that grit does not compensate for the effects of poverty, racial discrimination, or disability (Tefera et al., 2019), and may only compensate for low ability among students with high socioeconomic status (Gil-Hernández, 2021).

Some also argue that grit, often through its misguided conflation with compliance (e.g., doing homework, paying attention in class), teaches students to accept hardship and submit to authority, rather than fostering critical thinking or self-advocacy. This creates a character “perfectly suited to producing corporate drones” (Denby, 2016, para. 21) or “smart, ambitious, amoral people” (Rose, quoted in Strauss, 2021, para. 13). Critics advocate for shifting the focus away from grit and toward fostering political agency or pragmatist hope in youth, moving from adaptation to active transformation (Saltman, 2014; Stitzlein, 2020)²⁵.

Proponents of grit argue that it is simply about setting long-term goals and working hard to achieve them. Grit research does not deny the impact of societal forces on students’ opportunities, nor does it suggest that grit programs should be targeting only disadvantaged students (Herold, 2015). Duckworth (2016) herself highlights that grit development “depends critically on other people” (p. 269) and advocates for a “culture of grit” that includes “deep and rich support” (p. 266). She disputes the view of grit and growth mindset as deficit models, emphasizing that grit “is not about blaming the student”; rather, developing grit is “joint work”, with shared responsibility between students, educators, and society to create conditions for success. “I want kids to have agency”, she states, “but I also want society to take responsibility” (Duckworth, in McKibben, 2018, para. 10-13). This view aligns with Schreiner’s (2017) ‘thriving ideology’, which calls for addressing barriers while fostering malleable qualities in both students and educators. However, examples like the U.S. Dept. of Education’s focus on cultivating grit in students without addressing the necessary structural changes demonstrate the risks of misapplying grit research, effectively placing the onus back on students and sidestepping more resource-intensive changes (Schreiner, 2017).

These concerns are valid, and attributing underperformance solely to a lack of grit rather than social disparities is ill advised, especially given evidence that many individuals

²⁵ Ironically, hope is one of four resources Duckworth (2016) suggests could foster grit, though she frames it as an individual disposition / mindset rather than a collective action to improve circumstances.

born into poverty remain underprivileged *despite* academic success (Gonzalez Stokas, 2015; Willingham, 2016). Grit, in itself, is not inherently problematic and does predict important student success outcomes; concerns arise primarily when it is treated as *the* panacea for achievement gaps. However, interventions that encourage belief in personal effort—without downplaying systemic disadvantage—and emphasize perseverance without glorifying hardship could still improve student outcomes within the limitations posed by inequitable access to resources. Assuming that many children from underprivileged backgrounds already possess ‘in-built’ grit—e.g., through facing adversity, holding down jobs after school, or helping to raise younger siblings—teaching them how to transfer these skills to other areas, including academics, is worthwhile (Duckworth, in McKibben, 2018). Thus, fostering grit in children, whether disadvantaged or not, if done ethically and with deep respect for their needs and interests, as this study proposes, remains a meaningful goal in education. In Chapter 10, which contextualizes the research findings, I will use the metaphors of the ‘radical middle’ (Bell-Robinson, 2016) and ‘seed and soil’ (Walton & Yeager, 2020) to expand on this view.

2.8 Where the Research Gaps Are

2.8.1 Theoretical Considerations

A review of the literature reveals several promising avenues for grit research. Firstly, given empirical evidence suggesting limited incremental validity of grit beyond constructs such as conscientiousness (Credé et al., 2017; Ivcevic & Brackett, 2014; Muenks et al., 2017; Rimfeld et al., 2016), academic self-efficacy, or school engagement (Steinmayr et al., 2018), further research is needed to explore how grit uniquely contributes to performance outcomes, specifically examining its distinct effects relative to conscientiousness, self-control, self-efficacy, and mindset (Datu, 2021; Duckworth et al., 2007; Duckworth & Gross, 2014; Kannangara et al., 2018, 2020; Vazsonyi et al., 2019). Accordingly, these variables are included in the present study to disentangle grit’s effects from those of related constructs.

Secondly, despite growing interest in grit as a predictor of academic success, relatively little is known about its psychological antecedents. Constructs such as growth mindset, purpose, deliberate practice, self-control, and goal-setting are hypothesized to underpin grit (see section 3.2.3), yet their precise roles and potential as intervention targets remain largely underexplored. Addressing this gap could clarify the importance of these psychological resources and advance the development of interventions aimed at cultivating grit (Christopoulou et al., 2018; Datu, 2021; Schimschal et al., 2021).

Beyond the need to understand grit’s psychological antecedents, it is important to continue investigating the extent to which grit is skill-like. This involves not only assessing its

responsiveness to interventions but also identifying the *types of interventions* that might be effective (see Credé et al., 2017; Eskreis-Winkler, Gross, et al., 2016; Hwang & Nam, 2021; Pendyala & Vyas, 2023; Rimfeld et al., 2016). Although one study has compared the effectiveness of identical intervention content in self-study vs. teacher-led conditions (Santos et al., 2021), to my knowledge, no research has yet compared the effectiveness of different types of intervention content on both self-reported grit and objective success outcomes.

Fourthly, potential moderators of the relationship between grit and achievement warrant further exploration, including the *performance domain* (e.g., usefulness of grit for certain types of tasks or settings; stability or transferability of grit across situations, see also Duckworth & Quinn, 2009), *individual differences such as ability* (e.g., importance of grit for the most/least able, see also Eskreis-Winkler, Gross, et al., 2016), or *socioeconomic status* (e.g., relevance of grit for the disadvantaged/advantaged).

As a fifth point, there is insufficient knowledge on potential *behavioral mechanisms* that mediate the association between grit and success. Deliberate practice is one mechanism that has been shown to fully mediate this relationship for, e.g., competitors in a spelling bee (Duckworth et al., 2011). Downward counterfactual thinking—imagining a worse alternative to one’s present reality, which fosters gratitude—was found to mediate the relationship between grit and retention among military cadets (Kwok et al., 2013, cited in Eskreis-Winkler, Gross, et al., 2016). Moreover, school engagement is highly correlated with grit (Muenks et al., 2017; Suzuki et al., 2015; Von Culin et al., 2014) and has been explored as a mediator in the grit-achievement relationship (e.g., Hodge et al., 2018; O’Neal et al., 2018).

Lastly, with the exception of two doctoral research projects (Gibson, 2019; Hoskie, 2023), both prevailing conceptualizations of grit and grit-related interventions overlook the subjective and experiential dimensions of grit, prioritizing quantitative outcomes such as questionnaire responses and grades. This oversight restricts our understanding of how individuals perceive and engage with grit interventions, as well as the mechanisms and contextual factors that shape grit-related outcomes, leaving a gap in the literature.

Design and measurement limitations, such as sample range restriction, insufficient exploration of grit as a domain-specific construct, neglect of its relevance to subjective goals, limited assessment of multiple outcomes within single studies, scarcity of longitudinal grit research, absence of control groups and randomization in intervention studies, and the near lack of mixed-methods designs and participant-centered intervention evaluations, are discussed in detail in section 5.1.

2.8.2 Geographical Considerations: The German Case

Research on grit in European contexts is still in its infancy. In a thorough but non-exhaustive literature search up to 2024, I identified studies on grit (including variants like L2 grit) in samples from only 24 of Europe's 50 sovereign states. Most countries—except Turkey, Germany, Spain, and the U.K.—have fewer than seven grit-related studies²⁶.

In the German-speaking world, a nine-item grit scale was administered for the first time in the OECD PIAAC²⁷ field trial (2010), which included also adult participants from Austria and Germany. Researchers from the GESIS institute used this data to investigate the psychometric properties, distribution, and career-related correlates of grit among German adults. Their findings indicated that grit significantly predicts career engagement, over and above cognitive ability and sociodemographic characteristics, and has added predictive value beyond conscientiousness for career success (Lechner et al., 2019)²⁸.

Fleckenstein et al. (2014) translated the Grit-O scale into German and validated it with a sample of preservice teachers, finding significant associations between grit and gender (with women scoring higher), Abitur grades²⁹, conscientiousness, and generalized self-efficacy. Schmidt et al. (2019)³⁰ validated a German version of the Grit-S scale (BISS-8) and probed grit's domain specificity in a high school setting. Using a school-focused adaptation of the BISS-8, they found that school grit was a stronger predictor of GPA than general grit.

Beyond this validation study, research on grit in German classrooms remains limited but offers valuable insights. Grit-PE has been shown to predict secondary students' GPA, even when controlling for intelligence, conscientiousness, and other factors, though it was a weaker predictor than academic self-concept, expectancies for success, academic self-efficacy, and behavioral school engagement (Steinmayr et al., 2018). Kulakow and Hoferichter (2021) found that academic self-concept mediates the relationship between teacher-provided socio-emotional and competence support and school grit in 7th- and 8th-graders, while Obermeier et al. (2023) reported that grit partially mediates the relationship between stress and academic outcomes, suggesting that it may help students cope with stress

²⁶ Austria (3), Czech Republic (1), Denmark (1), Estonia (1), Finland (6), France (1), Germany (12), Hungary (1), Iceland (2), Italy (3), Luxembourg (1), the Netherlands (5), North Macedonia (1), Norway (6), Poland (5), Portugal (3), Romania (3), Russia (5), Spain (9), Sweden (3), Switzerland (2), Turkey (17), UK (8), Ukraine (1).

²⁷ Programme for International Assessment of Adult Competencies.

²⁸ This was the case even though grit was modelled as a facet of conscientiousness and measured with a 5-item scale consisting of four perseverance items from the Grit-S scale and only one consistency item, resulting in substantial conceptual overlap between grit and the industriousness/perseverance facet of conscientiousness.

²⁹ The Abitur is the highest German school leaving certificate (general qualification for university entrance).

³⁰ This article was available as a preprint in 2016, which allowed other researchers to begin using the BISS-8 scale before its official publication in 2019.

and feelings of helplessness. Hoferichter and Raufelder (2023) further noted that higher bodily stress responses negatively impact students' engagement and application of school grit in the classroom, underscoring the need to minimize stress to support engagement and grit.

Two studies in German samples focused on grit's relationship to conscientiousness. Schmidt et al. (2018) found that grit shares variance with conscientiousness facets like industriousness and self-discipline. Schmidt et al. (2020) further showed that grit-PE aligns closely with productiveness (but not organization or responsibility), while grit-CI is distinct from both grit-PE and conscientiousness. Additionally, grit's facets were stronger predictors of outcomes reflecting long-term effort, such as income, crystallized intelligence, and educational attainment, than conscientiousness facets.

Grit has also been explored in personal development contexts. Among adult German-speaking online gamers, Borzikowsky and Bernhardt (2018) found that higher grit levels were linked to a lower likelihood of game addiction, indicating that grit may protect against addictive behaviors. Separately, Wolff et al. (2022) found that the challenges of educational stays abroad foster different facets of grit over time, with grit-PE increasing within the first three months and grit-CI rising only after three months.

Given that only five of the 12 grit-focused studies in Germany examine grit within a school setting, there is evidently insufficient research to determine its significance in this specific educational context, which, by international standards, is marked by high levels of social segregation among pupils at the school level and significant achievement gaps. In 2022, socio-economic status (SES) accounted for 19% of the variation in mathematics performance, up from 16% in 2015 and well above the OECD average (OECD, 2016, 2023). Only 32% of children from socioeconomically disadvantaged families receive references for Gymnasium (Germany's academic-track secondary school), compared to 78% from more privileged families (Autor:innengruppe Bildungsberichterstattung, 2024). Academic competencies in reading and math are significantly lower among disadvantaged students, with gaps of roughly one learning year. Just 31% of these students attain the Abitur (high school diploma equivalent), compared to 79% from better-off families. Additionally, disadvantaged students are less likely to participate in non-formal learning opportunities or set career aspirations aligned with their abilities, as many face substantial barriers to vocational training or higher education (Autor:innengruppe Bildungsberichterstattung, 2022b).

There is also a stark discrepancy in educational outcomes for students with and

without a migration background or immigration history³¹. The share of immigrant students³² in Germany has doubled from 13% in 2012 to 26% in 2022. These students generally have a disadvantaged socio-economic profile compared to non-immigrant students; while 25% of *all* students are considered disadvantaged, the figure rises to 42% among immigrant students (OECD, 2023). In 2024, 59% of children with an immigration history are growing up with at least one of three high-risk factors³³, compared to 20% of children without such history (Autor:innengruppe Bildungsberichterstattung, 2024). These figures were lower just two years earlier, at 48% and 16%, respectively (Autor:innengruppe Bildungsberichterstattung, 2022b). In fact, the Expert Council of German Foundations on Integration and Migration analyzed 56 studies, revealing that students with a migration background face a *double disadvantage* in the German educational system. This disadvantage stems primarily from their social origin (e.g., parental education and social status) and is further compounded by their migration background, affecting both skill development—particularly German language proficiency—and educational choices (Research Unit, 2016).

In reading, immigrant students score 67 points lower than non-immigrant peers—a gap equivalent to more than two years of schooling—and the difference remains 40 points even after accounting for students’ socio-economic profile (OECD, 2023). This gap is similarly pronounced in digital competencies, where the difference between immigrant and non-immigrant students in Germany is *twice as high* as the EU average (Anders, 2024). Furthermore, students with a migration background are twice as likely to leave school without

³¹ The 2024 edition of “*Bildung in Deutschland*” (Education in Germany), a biennial government-funded report offering an overview of the German education system, introduces for the first time a distinction between *migration background* (Migrationshintergrund) and *immigration history* (Einwanderungsgeschichte). Migration background, depending on the data source, broadly includes individuals who themselves, or at least one parent or grandparent, were born outside Germany, though official data often focus on individuals who themselves, or at least one parent, lacked German nationality at birth. By contrast, the newly introduced immigration history category is narrower, encompassing only individuals who themselves, or whose parents *both*, immigrated to Germany since 1950, excluding one-sided migration backgrounds and grandparental origins (Autor:innengruppe Bildungsberichterstattung, 2024). In most sources referenced in this doctoral project, the term migration background is not defined and is likely used in its broader sense. At the school level, where data on parents’ or grandparents’ countries of birth is unavailable, references to students with a migration background often rely on perceived characteristics—such as foreign-sounding names, non-German ethnicity, religious affiliations other than Christianity, use of a language other than German at home, or poor German proficiency—an approach that is problematic in many ways but cannot be addressed within this study. Therefore, the term immigration history will be used when explicitly stated in the source, such as in the *Bildung in Deutschland 2024* report. Migration background will be applied whenever ‘Migrationshintergrund’ is mentioned in the source, as in the *Bildung in Deutschland 2022* report. The OECD’s definition of ‘immigrant students’, which differs slightly, is detailed in footnote 32. In all other cases, *migration background* will be used in its broader sense, aligning with the general usage of this term, particularly in sources predating the past few years.

³² The OECD defines immigrant students as those whose parent(s) were born in a different country/economy from the one where the student attends school, making this category broader than immigration history (as it includes students with only one parent born outside Germany) but narrower than migration background.

³³ i.e., formally low-qualified parents, unemployed parents, and risk of poverty in the household.

a lower secondary certificate (Hauptschulabschluss) and three times less likely to achieve the Abitur (Autorengruppe Bildungsberichterstattung, 2016).

These social and migration-related educational disparities present significant barriers to achieving equal societal participation and preparing all children in Germany for self-determined lives. Intervening to foster grit at school—where *all* students, regardless of background, could potentially benefit—offers some hope for reducing achievement gaps, particularly where inadequate family-focused policies fail to engage disadvantaged families (Alan et al., 2019). Such interventions should be seen as one of many tools that may support students in setting ambitious educational goals and persevering through challenges.

2.9 What This Research Aims to Discover About Grit

The research questions in this mixed-methods project are informed by gaps in the existing grit literature and are designed to address these limitations. Theoretically, they aim to explore grit's contribution to academic performance relative to related constructs, its psychological antecedents and responsiveness to interventions, the effectiveness of different intervention types, moderators such as performance domain or socioeconomic status, mediating mechanisms in the grit-achievement relationship, and the subjective dimensions of grit that remain underexplored. Methodologically, they address design and measurement limitations by incorporating a school-specific grit measure, diverse and multiple outcome variables, a longitudinal cluster-randomized controlled design, and qualitative data to complement and enrich quantitative findings. While not explicitly stated in the research questions, the project also addresses a contextual and demographic gap in grit research, as studies on grit in German school settings are extremely scarce.

The specific questions guiding this research are as follows:

Pre-intervention examination of grit, related constructs, and school performance (Ch. 7)

- » RQ 1: How do domain-general and school-specific grit relate to other constructs in their nomological network?
- » RQ 2a: How strongly do students' grit and the other variables relate to students' GPA? Do the grit variables explain unique variance in GPA over and above other constructs?
- » RQ 2b: What is the relative importance of the grit variables for GPA when including all other predictors simultaneously in the analytic model?
- » RQ 2c: Is the impact of grit on GPA moderated by students' socio-educational advantage (SEA)³⁴, gender, cohort, or academic ability?

³⁴ The socio-educational advantage (SEA) index is described in Chapter 6, section 6.4.

- » RQ 2d: Is the impact of grit on GPA mediated by students' school engagement?

Longitudinal analysis of the academic and behavioral outcomes of grit interventions (Ch. 8)

- » RQ 3x: How do the one-time web-based grit interventions affect ...
 - a: self-reported levels of domain-general and school-specific grit over time?
 - b: self-reported levels of conscientiousness, school belonging, school self-control, school self-efficacy, and fixed / growth mindset over time?
 - c: self-reported levels of school engagement over time?
 - d: the achievement of self-selected personal and school goals post-intervention?
 - e: students' GPA over time?
 - f: students' academic progress as evaluated by teachers post-intervention?
 - g: students' educational attainment?
- » RQ 4: Which is the most effective grit intervention with respect to any of the outcomes measured in this study?
- » RQ 5: Which groups of students benefit more from any of the interventions than their peers? Are the interventions particularly effective for socially disadvantaged or poorly performing students?
- » RQ 6: What are the mechanisms underlying the effect of the grit interventions on GPA? Is students' school engagement mediating this relationship?

Student perspectives on school, learning, and the impact of the grit interventions (Ch. 9)

- » RQ 7: What are the academic mindsets and behaviors underlying the effects of the grit interventions?
- » RQ 8: How do students evaluate the grit interventions?

RQs 1, 2b, and 8 are exploratory in nature and do not involve pre-specified hypotheses. Hypotheses for the remaining RQs are detailed in their respective chapters (7, 8, and 9), alongside analyses and results. This balanced approach allows the study to test specific theoretical predictions while also addressing previously unexplored aspects of grit within this particular educational context.

3 Theoretical Framework: (Re)Imagining Grit

3.1 Assumptions

Before describing the model that serves as a basis for the proposed grit interventions, a brief clarification of the assumptions underlying this model is necessary. Psychologists have emphasized the importance of non-cognitive skills in promoting optimal psychological health in children and adolescents. There is also growing recognition of the educational benefits of fostering these skills within school settings. Although grit has its critics, as discussed in detail in section 2.7, this research assumes that grit, like other character strengths, is a *positive* attribute that is “generally accepted as beneficial to the student and to others in society” (Duckworth & Yeager, 2015, p. 239).

The second assumption implicit to the proposed model is that grit is not *one thing* that can be taught or enhanced directly but rather *many things* that combine and ultimately determine an individual’s grittiness (Duckworth, 2016). Grit can be thought of as a “bundle of beliefs, attitudes and strategies ... that enable follow-through on a goal in the face of obstacles” (Holbein et al., 2020, p. 1441). Among others, grit is assumed to encompass subjective task values (e.g., intrinsic value), expectancies for success (e.g., self-efficacy), beliefs (e.g., growth mindset), motivations (e.g., sense of purpose), goal orientations (e.g., learning goal orientation), emotions (e.g., optimism, enjoyment), self-regulation skills (e.g., self-control, emotional regulation), and metacognitive skills (e.g., planning, goal-setting). The primary intent of this study is not to conclusively identify all of grit’s constituents but to enhance it by targeting those most likely to precede and influence its development, conceptualized here as its *psychological antecedents*.

The vast majority of grit research is cross-sectional / correlational, identifying attributes that are associated with grit but not necessarily causally linked to its development (see section 2.3). In contrast, psychological antecedents of grit require evidence of causality, which can be established through longitudinal designs showing that specific attributes contribute to grit’s development *over time*, experimental manipulation allowing researchers to observe causal effects on grit or performance outcomes, or intervention studies demonstrating that targeting factors like growth mindset results in measurable increases in grit or gritty behaviors. Only attributes for which there is such evidence—or at least a justified expectation that they serve as antecedents—will be considered in this chapter.

3.2 (Psychological) Antecedents of Grit

To explore how grit can be influenced through intervention, it is essential to

understand its origins, the extent to which it is shaped by genetic predispositions versus environmental influences, and the psychological factors that may contribute to its development—the latter being the primary focus of the current research.

3.2.1 The Genetics of Grit

In the context of studies examining grit's heritability, genetics refers to the inherited traits and predispositions passed down from parents that contribute to individual differences; the shared environment encompasses influences that siblings experience similarly, such as family upbringing or socioeconomic status; and the non-shared environment captures unique experiences that differ between siblings, such as distinct peer groups, individual life events, or personal interpretations of shared experiences. This distinction is relevant as research on grit's heritability shows that, just like personality traits such as conscientiousness, grit is predominantly influenced by genetic factors, with minimal contribution from shared environmental conditions. Rimfeld et al. (2016) found that grit is moderately heritable, with genetic factors explaining approximately 37% of the variance in perseverance of effort and 20% in consistency of interest, and no evidence of shared environmental influence. Similarly, Kevenaar, Dolan, et al. (2023) found that grit-PE and self-control are substantially heritable (58% and 69%, respectively), and that the genetic component of grit accounts for most of the variance in school performance explained collectively by grit and self-control. However, a significant portion of the remaining variance in grit (27% out of 42%) stems from non-shared environmental factors—unique personal experiences—suggesting that interventions targeting shared environments, such as family or school policies, are unlikely to be effective unless they create distinctive and meaningful experiences for individuals, such as personalized challenges, mentoring relationships, or efforts to boost intrinsic motivation.

While genetic factors play a significant role in shaping grit, they do not imply immutability. Genetic predispositions interact with environments, and novel interventions (not currently part of the natural environmental variation) could still influence grit (Rimfeld et al., 2016). Kevenaar, Van Bergen, et al. (2023) note that although the causal contribution of grit to school performance was modest (4.4%) after accounting for genetic influences that grit, self-control, and school performance share, interventions targeting grit and related traits could still yield benefits, especially for children with low grit and self-control.

3.2.2 Environmental Factors Shaping Grit

After exploring the genetics of grit, the next logical focus is the child's family—particularly parenting style—which represents the microsystem where the most immediate environmental influences on a child's development occur. Studies have consistently shown

that positive parenting behaviors, such as parental autonomy support and authoritative (but not authoritarian or permissive) parenting styles, are associated with higher levels of grit in children and adolescents (Du et al., 2023; Fernández-Martín et al., 2023; Fun Fun et al., 2023; Guerrero et al., 2016; Howard et al., 2019; L. M. A. Lee & Datu, 2022; Lin et al., 2024). Notably, grit also mediates the link between authoritative parenting and academic success (Howard et al., 2019). In contrast, negative parenting practices, such as harsh discipline (Cui & Lan, 2020), overparenting (Howard et al., 2019), and adverse experiences like neglect and emotional abuse (Cheung et al., 2021), are linked to lower levels of grit, emphasizing the importance of a supportive family environment³⁵.

Several studies have identified mechanisms through which parenting influences grit. Lin, Liu, et al. (2024) found that positive parenting not only predicts academic grit directly but also indirectly through personal growth initiative and conscientiousness. Du et al. (2023) showed that parental autonomy support—encouraging children’s independence— promotes grit by fulfilling basic psychological needs (BPN) for autonomy, competence, and belonging. Satisfaction of these needs has been linked to higher grit, either directly or indirectly via e.g., intrinsic motivation (Çınar-Tanrıverdi & Karabacak-Çelik, 2023; Huéscar Hernández et al., 2020; Jang et al., 2023; Santana-Monagas & Núñez, 2022; Shirvan & Alamer, 2022).

In addition to parenting style, socioeconomic characteristics of individuals and their parents are associated with grit development. Parental employment (Guerrero et al., 2016), perceived social class and parental education (Kwon, 2021), and socioeconomic status (e.g., Cui & Lan, 2020; Tang et al., 2019; Usher et al., 2019) show positive correlations with grit, particularly grit-PE. Thus, while grit has a strong genetic basis, supportive parenting styles and favorable socioeconomic conditions provide important foundations for its development.

Furthermore, the *social context* in which individuals mature can shape grit, as its interaction with situational characteristics helps determine success or performance (Credé, 2018; Jordan et al., 2019). In settings lacking supportive characteristics, grit’s impact may be diminished or nonlinear (Jordan et al., 2019). After exploring the influences of genetics and family, the next critical environmental factors shaping grit are found in the school context, including relationships with teachers and peers, as well as the broader school culture.

Research highlights that relationships with peers (Lan & Moscardino, 2019) and a feeling of school connectedness (Renshaw & Bolognino, 2016) are positively associated with

³⁵ Other non-cognitive attributes essential for academic achievement, such as self-esteem / self-efficacy (which exhibit strong correlations with grit), are likewise positively influenced by supportive family environments. These environments are marked by family members’ satisfaction with family dynamics and further characterized by high parental involvement and “student-perceived caring lenience of parents” (Boehnke, 1996, p. 219).

grit. A sense of relatedness to teachers and peers helps students sustain interest and effort in their pursuits, suggesting that supportive educational environments are important requisites for grit (Datu, 2017). Perceived teacher support is especially influential, positively predicting grit and motivating students in educational settings (Chen, 2023; Hejazi & Sadoughi, 2023). One mechanism by which teacher support impacts grit is by nurturing students' learning enjoyment (Hejazi & Sadoughi, 2023). Additionally, teacher-induced autonomy support has been linked to the satisfaction of BPN, fostering intrinsic motivation, which in turn predicts grit (Huéscar Hernández et al., 2020). Teacher support also moderates the link between grit and academic success (Clark et al., 2020).

Classroom-level factors also contribute to the development of grit. Mastery-oriented school goal structures and the presence of gritty peers in the classroom have been found to enhance individual grit (O'Neal et al., 2018; D. Park et al., 2018). Notably, an experimental study demonstrated that perseverance on a task—a behavioral measure of grit—is influenced by peer effects, with individuals displaying greater grit simply by observing gritty behavior in their peers (Gerhards & Gravert, 2020). Moreover, a need-supportive climate was found to promote students' identification with school and academic grit (Adams & Khojasteh, 2018).

While the grit interventions in this project cannot directly influence the students' family environment, the attitudes of non-participating peers and teachers, or the overarching school culture, this limitation does not diminish the role these contextual factors play in determining whether students can manifest and sustain grit in school and beyond. The importance of a supportive context will be revisited in the general discussion, particularly section 10.1.9 of the final chapter, where the interplay between individual and environmental factors is considered in greater detail.

3.2.3 Psychological Antecedents of Grit

Turning to the *intrapersonal antecedents of grit*, which this study prioritizes, Duckworth (2016) proposed four essential psychological assets—interest, purpose, practice, and hope—as the foundation for sustained effort and commitment toward prized goals³⁶.

Research findings provide preliminary support for the relevance of these psychological resources, starting with *interest*, which emphasizes finding and sustaining

³⁶ Building on Duckworth's theory, Schimschal, Visentin, et al. (2022) proposed a more detailed framework that links each of these assets to four specific attributes. In their model, interest is associated with curiosity, self-awareness, courage, and patience, enabling individuals to develop and deepen their passions. Purpose encompasses self-determination, self-concordance, self-compassion, and emotional intelligence, all of which contribute to making one's interests more meaningful and aligned with long-term goals. Practice is connected to hardiness, resilience, self-efficacy, and flow, which foster persistence and skill development through sustained effort. Finally, hope integrates goal orientation, growth mindset, optimism, and self-regulation, equipping individuals with the confidence and strategies necessary for pursuing and achieving ambitious goals.

intrinsic enjoyment in one's pursuits. Conceptually, it stands to reason that having interests—described as “the seeds needed to develop a passion” (Van Der Vaart et al., 2021, p. 244)—is a prerequisite for grit, as without them, there would be no basis for its consistency of interests component. But what psychological factor helps individuals discover and develop such interests or passions? Intrinsic motivation, defined as the tendency to seek out novelty and challenges, has been proposed as a key driver. While mediation analyses alone cannot establish antecedence, one study found that intrinsic motivation predicts both facets of grit, with grit-PE mediating the relationship between intrinsic motivation and academic performance (Huéscar Hernández et al., 2020). Supporting this, an experimental study demonstrated that grit enhances performance on a word problem-solving task, but only in the presence of intrinsic motivation. Conversely, costly perseverance—the tendency to persist in a task even when it becomes disadvantageous—reduced grit's performance benefits, suggesting that intrinsic motivation is necessary for grit to be effective (Chen, 2018).

As mentioned briefly under motivational correlates of grit (section 2.3), a *sense of purpose* has also been associated with grit. Purpose provides motivation by linking individual goals to a broader, often altruistic, framework. In a longitudinal study, Hill et al. (2016) demonstrated that purpose commitment uniquely predicted grit, showing that purpose, more than positive affect, is a strong driver of sustained effort over time. Findings by Yeager et al. (2014) further revealed that an intervention targeting a self-transcendent purpose for learning helped students stay engaged with boring test review materials and maintain self-discipline during a task that became more tedious over time, both indicative of gritty behavior.

Already introduced in section 2.3 as one of grit's “key downstream behavioral correlates” (Eskreis-Winkler, 2015), *deliberate practice* can strengthen neural pathways associated with grit over time, thereby enhancing grit itself (Hwang & Nam, 2021). Supporting this premise, findings from rigorous controlled interventions indicate that deliberate practice can enhance grit and improve performance outcomes (Eskreis-Winkler, Shulman, et al., 2016; Santos et al., 2021). These interventions targeted *practice-specific* expectancies and costs by emphasizing the value of deliberate practice over innate talent and encouraging students to reframe frustration and effort as indicators of meaningful progress. Structured extracurricular activities offer another avenue to cultivate grit through deliberate practice (Duckworth, 2016). For instance, Major's (2013) mentoring program involving intense fitness exercises and deliberate practice increased grit in adolescents over six months.

Finally, Duckworth (2016) highlighted *hope* as a psychological asset of grit, defining

it as the belief that effort can improve future outcomes³⁷. Hope is characterized by goal-directed thinking that combines setting meaningful goals, developing pathways to achieve them, and possessing agency (i.e., motivation, determination, anticipating and preparing for obstacles). Among grit's many correlates, hope is one of the few shown to predict increased levels of grit *over time* (Raphiphatthana & Jose, 2021)³⁸. Duckworth (2016) advocates cultivating hope—and by extension, grit—through two strategies: developing a *growth mindset* by revising beliefs about intelligence and talent, and practicing optimistic self-talk, grounded in optimistic explanatory style and resilience training. Within the theory of hope, a growth mindset has implications for both the agency and pathways aspects of hope. Because hope and grit share the underlying belief inherent in a growth mindset—that life and abilities can improve with effort—it is unsurprising that these constructs are closely connected, with growth mindset likely to play a pivotal role in fostering both (Raphiphatthana & Jose, 2021; Van Der Vaart et al., 2021). Grit has been shown to mediate the relationship between growth mindset and academic achievement or engagement, suggesting that growth mindset may act as an antecedent of grit, though mediation alone does not establish causation (Fathi et al., 2024; Kaya & Karakoc, 2022; J. Kim & Park, 2017; J. L. Lee & Kwon, 2016; Seo & Kim, 2020). Supporting these findings, a neuroanatomical study in adolescents found that growth mindset mediates the relationship between left dorsolateral prefrontal cortex (DLPFC) volume and grit, underscoring its potential role in fostering grit (S. Wang et al., 2018). Finally, longitudinal research confirmed that grit and growth mindset are mutually reinforcing during childhood and adolescence, with each predicting increases in the other over time (D. Park et al., 2020; T. Zhang et al., 2022). This dynamic suggests that growth mindset serves as an antecedent of grit, while grit also contributes to the development of growth mindset.

Emerging evidence from intervention studies provides further support for the role of hope, optimism, and growth mindset as interrelated psychological antecedents of grit. Interventions targeting hope (Firoozmokhtar et al., 2023; Hellman & Gwinn, 2017) or incorporating optimism components (Carrier Lyon, 2014; Hellman & Gwinn, 2017) have demonstrated their potential to enhance grit. Similarly, interventions exclusively or partially focused on fostering a growth mindset have increased grit (or perseverance) in various contexts (Alan et al., 2019; Carrier Lyon, 2014; Mirza et al., 2021; O'Rourke et al., 2014;

³⁷ Incidentally, this definition is very similar to the definition of growth mindset, which is the belief that intelligence and abilities can be developed through effort.

³⁸ The finding that hope predicted increased levels of grit over time, but not vice versa, indicates that hope plays a role in fostering grit, whereas grit does not typically contribute to the development of hope.

Sigmundsson & Hauge, 2023; Sinclair, 2021; Smith, 2017; Zappala-Piemme et al., 2023)³⁹.

Outside the framework of interest, purpose, practice, and hope, *mindfulness* has emerged as a potential antecedent of grit. While several studies have documented significant positive correlations between mindfulness and grit (as noted in section 2.3), longitudinal research provides more compelling evidence. Specifically, components of mindfulness, such as acting with awareness and non-judgment, have been identified as the strongest positive predictors of grit measured at a later time point (Raphiphatthana et al., 2018). The findings indicate a unidirectional relationship, where mindfulness significantly predicts changes in grit over time, suggesting that mindfulness acts as an antecedent to grit rather than the other way around. This theory is further supported by recent evidence from two controlled and one uncontrolled multi-session mindfulness-based interventions, all of which successfully enhanced self-reported grit (Mohebi et al., 2021; Rahimpour et al., 2019; Rusadi et al., 2023).

Self-regulatory attributes such as *dispositional self-control* may also be important for grit development. Self-control allows individuals to resist momentary distractions and align their actions with valued goals (Duckworth & Gross, 2014). Duckworth (2016) and Jordan et al. (2019) highlighted the importance of proximal goals as stepping-stones toward higher-order aspirations, while Duckworth and colleagues (Duckworth, Taxer, et al., 2019; Duckworth & Gross, 2014; Duckworth & Seligman, 2017) argued that self-control is crucial for managing these proximal goals. Consequently, self-control can be seen as a precursor of grit, as the pursuit of superordinate goals relies on successfully navigating and achieving multiple lower-level goals. The ability to delay gratification, a core aspect of self-control, has also been proposed as a potential antecedent of grit (Duckworth & Eskreis-Winkler, 2013; Hwang & Nam, 2021), with early childhood differences in delaying immediate rewards predicting grit in adolescence (S. Park et al., 2020). Beyond substantial correlational evidence linking grit and self-control (see section 2.3), intervention studies further support this relationship. For instance, self-distancing—a self-control strategy that involves adopting an outsider’s perspective—has been shown to enhance perseverance in young children (R. E.

³⁹ While I am not aware of any studies linking Mental Contrasting with Implementation Intentions (MCII) to hope theory, the theoretical overlap between the two suggests that MCII could serve as a technique to bolster the cognitive components central to hope. MCII is a self-regulation strategy that combines mental contrasting—imagining a desired future and identifying current obstacles—with implementation intentions, which are specific ‘if-then’ plans to overcome those obstacles (Duckworth, Grant, et al., 2011). Both MCII and hope theory emphasize setting meaningful goals, identifying pathways to achieve them, and maintaining the motivation to pursue those goals despite obstacles. While hope theory focuses on the broader cognitive processes that underpin goal-directed behaviour, MCII can be viewed as a practical tool to operationalize the principles of hope theory: it makes pathways thinking actionable by requiring individuals to identify obstacles and plan solutions and it reinforces agency by promoting a sense of preparedness through pre-decided ‘if-then’ plans.

White et al., 2017). Additionally, interventions incorporating self-control / self-regulation strategies have increased grit and improved achievement outcomes (Carrier Lyon, 2014; Gorin et al., 2024; Hellman & Gwinn, 2017; Mirza et al., 2021; Santos et al., 2021).

Finally, the ability to *set and achieve goals* may contribute to grit by providing clarity and structure. Research suggests that individuals with well-defined, actionable goal hierarchies are better equipped to sustain effort and interest, even when faced with setbacks (Duckworth, 2016; Southwick et al., 2019). Mental Contrasting with Implementation Intentions (MCII), a goal-setting strategy that combines visualizing goals with identifying obstacles and actionable solutions, has been proposed as a method for promoting grit (Almeida, 2016; M. Jones, 2018; Keegan, 2017; SRI International, 2018). Supporting this, goal commitment—a volitional psychological bond reflecting dedication to a specific goal—measured in Grade 6 has been shown to predict higher levels of grit-PE in Grade 8, which subsequently influenced GPA and school engagement by Grade 9 (Tang et al., 2019). Moreover, preliminary evidence from grit intervention research confirms that both grit and academic outcomes can be enhanced through curricula that include goal-setting strategies (Alan et al., 2019; Song, 2019, cited in Hwang & Nam, 2021; J. Rhodes et al., 2018).

Grit’s Antecedents in Educational Settings. After exploring the psychological resources most likely to contribute to grit’s development, based on evidence from mediation, longitudinal, experimental, and intervention studies, a key question arises: how can these assets be conceptualized in an educational context? Enhancing grit in a school setting goes beyond simply improving scores on self-report measures; the ultimate goal is for grit to foster beneficial learning behaviors and positively influence academic outcomes. Understanding how these intrapersonal assets interact and combine to produce such effects in an academic environment can inform the development of effective strategies for school-based grit interventions. Drawing on insights from educational psychology, early research on non-cognitive skills, SEL programs, academic mindsets, and grit, several U.S. research institutions and foundations have proposed theoretical models that illustrate how mindset and skill development can promote academic success, highlighting grit’s role within this framework.

According to Dweck et al. (2011, republished in 2014)⁴⁰, academic tenacity refers to the *mindsets and skills* that enable students to work diligently and strategically toward long-term or higher-order academic goals, persisting through challenges and setbacks. This concept aligns closely with grit, which the authors identify as an “important factor in academic

⁴⁰ This report, “Academic tenacity: Mindsets and skills that promote long-term learning”, funded by the Bill and Melinda Gates Foundation, was authored by Stanford University psychologists Dweck, Walton, and Cohen.

tenacity” (p. 13). Academically tenacious students believe they belong in school socially and academically (*social belonging*), view school as relevant to their future goals (*purpose*), work hard and delay immediate gratification (*self-regulation and self-control*), remain engaged over time (*grit*), engage in learning by embracing effort and challenges (*growth mindset, mastery/learning and cooperative goal orientations*), and know how to deploy effective (*learning*) *strategies*. The authors stress that academic tenacity is teachable and that interventions targeting these non-cognitive factors can lead to measurable improvements in student achievement. Specifically addressing grit, they suggest that the factors central to academic tenacity may also foster grit, stating: “What is the relationship between grit and the mindsets and goals discussed earlier? ... Students who have a *growth mindset about intelligence, learning goals, a higher-order purpose, and a sense that they belong in school* [emphasis added] may well show more grit in their academic work. ... Mindsets, goals, and self-regulatory skills ... play key roles in this enterprise” (p. 13).

Farrington et al. (2012)⁴¹ build on this work and conflate grit with academic tenacity, integrating it into a broader non-cognitive factor called *academic perseverance*, which also includes delayed gratification, self-discipline, and self-control. Their model illustrates how five non-cognitive factors—academic mindsets, academic perseverance, learning strategies, social skills, and academic behaviors—interact to influence academic performance within a classroom/school and larger socio-cultural context. At the core of the model are *academic mindsets*—psychosocial beliefs that drive students’ willingness to engage and persist in academic tasks. These include a sense of belonging (‘I belong in this academic community’), growth mindset (‘My ability and competence grow with my effort’), self-efficacy (‘I can succeed at this’), and value / relevance (‘This work has value for me’). These mindsets drive academic perseverance (including grit), which manifests itself through academic behaviors like attending class and completing assignments, leading to improved performance. *Learning strategies*—study skills, metacognitive strategies, and goal-setting—affect behaviors both directly and via academic perseverance. *Social skills*, such as empathy, cooperation, assertion, and responsibility, foster positive interactions that support engagement. The process includes a feedback loop where improved performance reinforces positive mindsets, while the broader classroom, school, and socio-cultural context shapes these dynamics.

⁴¹ The critical literature review “Teaching adolescents to become learners” was prepared by the University of Chicago Consortium on Chicago School Research (CCSR), which conducts research informing and assessing policy and practice in Chicago public schools.

In a related effort, Snipes et al. (2012)⁴² outlined a Theory of Action positing that academic mindsets, aided by a set of key learning strategies, foster academic behaviors that can improve academic and learning outcomes, which, in turn, reinforce positive mindsets. In this model, the *academic mindsets* encompass ‘passion and purpose’, ‘grit and growth’, and ‘identity and community’. The *learning strategies* include study skills, self-regulated learning, time management skills, goal-setting, help-seeking behaviors, and metacognitive strategies. *Academic behaviors*, in turn, comprise attendance, homework completion, effective work and study habits, and active participation in class activities and discussions.

In an attempt to consolidate the aforementioned research, SRI International (2013, republished in 2018)⁴³ developed a hypothesized model of grit, tenacity, and perseverance, along with the contextual factors and psychological resources that promote them. This model highlights the need for a multifaceted approach to fostering grit, integrating three categories of psychological resources: *academic mindsets* (the four outlined by Farrington et al., 2012, plus ‘Challenge is inevitable for success’), *effortful control* (encompassing self-discipline, self-control, delay of gratification, and emotional regulation), and *strategies and tactics* (covering task definition, goals and plans, enactment and monitoring, deliberation and adaptation). Interventions must be context-sensitive, occurring within “rigorous and supportive” (p. 31) learning environments that enable students to set and pursue meaningful goals, provide opportunities for practice, feedback, and reflection, prioritize effort over ability, and foster fairness, respect, and care. This model, alongside those by Farrington et al. (2012) and Snipes et al. (2012), is included in Appendix A, p. 314.

Conclusion. The numerous parallels between these models and research on the psychological antecedents of grit (see pp. 44–48), including Duckworth’s (2016) framework of interest, purpose, practice, and hope, provide a solid foundation for understanding grit. By fostering psychological assets that underpin grit—such as academic mindsets (e.g., growth mindset, sense of belonging, and sense of purpose) and strategies (e.g., goal-setting)—interventions can promote the development of grit in educational contexts.

3.3 A Hypothesized Model of Grit

Building on the research discussed in this chapter regarding grit’s likely antecedents, it is posited here that being gritty involves having the ‘right’ *mindsets* and the necessary *skills and strategies* to persevere in the pursuit of long-term goals. In education, these can be further

⁴² This report on “Student academic mindset interventions” was commissioned by the Stupski Foundation, in collaboration with the Learning Lab Network—comprising educators, students, and community leaders.

⁴³ SRI International, a nonprofit scientific research institute, developed the research brief “Promoting grit, tenacity, and perseverance” in consultation with the U.S. Department of Education.

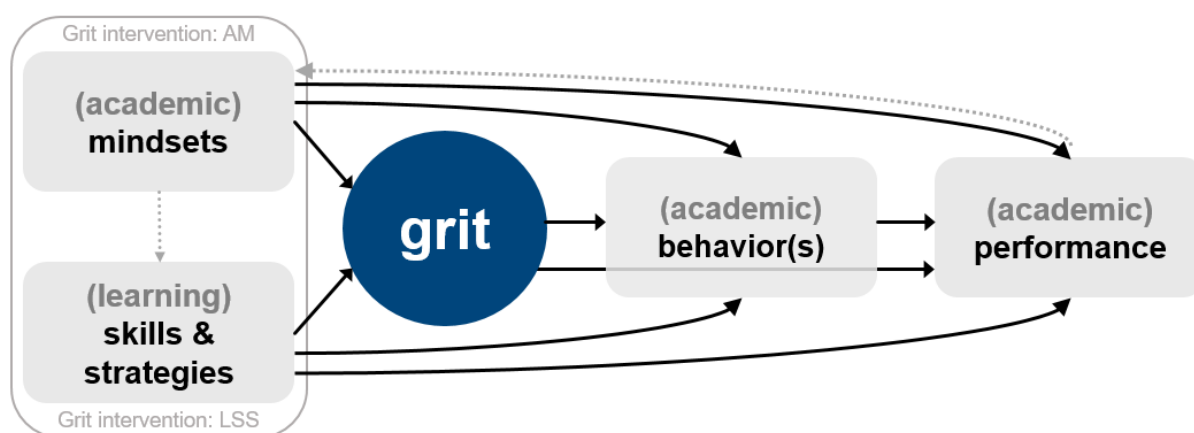
specified as *academic* mindsets and *learning* skills and strategies. Expanding on this premise, the current study introduces a streamlined causal model of grit and its relationship to performance (Figure 3.1, below), proposing that these mindsets and skills enable individuals to exhibit grit, which manifests through specific behaviors that drive performance outcomes.

While factors related to the classroom, school, educational system, and broader socio-cultural context undoubtedly play a role in shaping grit, they fall outside the scope of what can be influenced within the confines of this doctoral project. Given these limitations, this study focuses solely on psychological assets that promote grit, an area where targeted interventions have shown to have a meaningful impact. This leads to an important consideration: Which *specific* academic mindsets and learning skills and strategies should be prioritized in interventions designed to cultivate grit?

The *academic mindsets* literature can be grouped into three broad categories: beliefs about competence, values and goals, and beliefs about social belonging (SRI International, 2018). The first, beliefs about competence, include self-concept of ability, i.e., the appraisal of one's (past) performance relative to others (Morrison Gutman & Schoon, 2013); self-efficacy, the confidence in one's ability to achieve desired (future) outcomes ("I can succeed at this", Farrington et al., 2012, p. 29), growth mindset, the belief that intelligence can grow with effort and learning ("My ability and competence grow with my effort", Farrington et al., 2012, p. 28); and the awareness that challenges are unavoidable and can be attributed to

Figure 3.1

A Hypothesized Model of Grit and Its Relation to Performance



Note. Black arrows represent relationships that are addressed in the proposed research design while dotted arrows represent assumed relationships (such as the feedback loop between academic performance and mindsets) that cannot easily be tested in the current study.

external causes (“Challenge is inevitable for success”, SRI International, 2018, p. 37)⁴⁴.

The second category, values and goals, aligns with several motivational theories, including intrinsic/extrinsic motivation, expectancy-value theory, and achievement goal theory (Morrison Gutman & Schoon, 2013). Central to this category is the belief that academic tasks are interesting, personally relevant, and have a (higher) purpose (e.g., “This work has value for me”, Farrington et al., 2012, p. 29; or “This work is in line with my interests, values, or goals”, SRI International, 2018, p. 38). Two key constructs underpin this belief: sense of purpose, which connects academic activities to broader, meaningful goals, and task values, derived from expectancy-value theory, which encompass perceptions of a task’s importance (attainment value), enjoyability (intrinsic value), and usefulness (utility value). This category also includes goal orientations, with evidence suggesting that learning / mastery goals, cooperative / communal goals, and long-term goals are more conducive to success than performance, competitive / individualistic, or short-term goals (Dweck et al., 2014).

Finally, beliefs about social connectedness and belonging include one’s sense of belonging in a classroom or school, shaped by the nature and quality of relationships with teachers and peers (“I belong in this academic community”, Farrington et al., 2012, p. 28). Feelings of belonging also reduce stereotype threat by preventing negative experiences in school—such as loneliness, discrimination, bullying, or criticism—from being interpreted as confirmation of negative group stereotypes, especially ethnic ones (Yeager & Walton, 2011).

The *skills and strategies* proposed as necessary for pursuing long-term or higher-order goals with dedication and perseverance can be broadly categorized into self-regulatory skills and learning strategies. Self-regulatory skills—classified by Farrington et al. (2012) under academic perseverance and by SRI International (2018) under effortful control—include self-discipline, self-control (encompassing delay of gratification), and emotion regulation. Learning strategies encompass techniques such as study skills, deliberate/deep practice⁴⁵, help-seeking behaviors, goal-setting, and metacognitive strategies, all of which support sustained effort and effective progress toward academic goals.

By comparing the models of non-cognitive factors influencing academic performance proposed by Farrington et al. (2012), Snipes et al. (2012), and SRI International (2018) with

⁴⁴ Not all categorizations agree on where certain beliefs should be placed. For instance, Morrison Gutman and Schoon (2013) place beliefs about intelligence (e.g., growth vs. fixed mindset) under achievement goal theory, whereas Hulleman et al. (2016) classify growth mindset interventions as a subset of expectancy interventions within expectancy-value theory. Yeager and Walton (2011), in contrast, group growth mindset interventions under attribution interventions. Adding to the diversity of perspectives, Lazowski and Hulleman (2016) treat theories of intelligence as distinct from attributions, achievement goals, or expectancies for success.

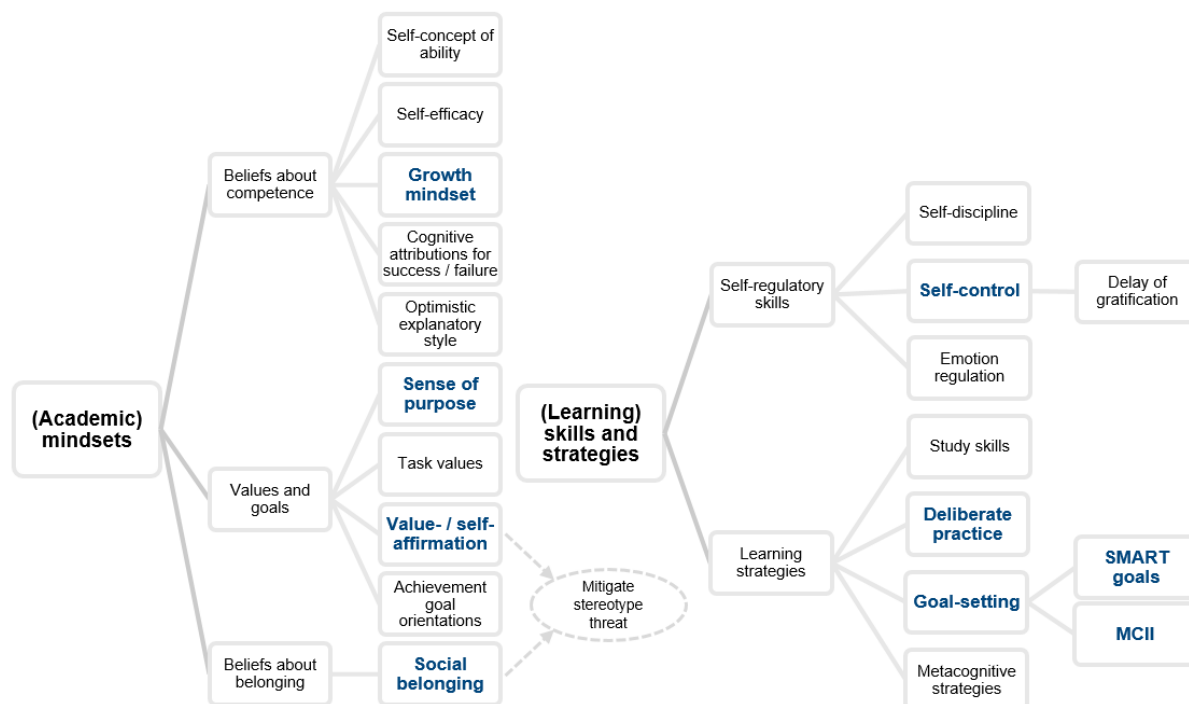
⁴⁵ Deliberate practice, though mentioned under effortful control by SRI International (2018), is arguably better conceptualized in the school context as a learning strategy.

recent findings on the psychological antecedents of grit (section 3.2.3), several sensible targets for grit interventions emerge: **growth mindset** (*beliefs about competence*), **sense of purpose** and **affirmation of personal values** (*values and goals*), **school belonging** (*beliefs about social belonging*), **self-control** (*self-regulatory skills*), as well as **deliberate practice** and **goal-setting** (*learning strategies*). Although the affirmation of personal values has not yet been empirically linked to grit (and was therefore not included as a potential antecedent), it “can serve to bolster the mindsets, ‘I can succeed at this’ and ‘I belong in this academic community’” (SRI International, 2018, p. 66), and may help mitigate the effects of stereotype threat—a challenge particularly relevant for students with migration backgrounds in German schools (Spencer et al., 2014). Figure 3.2 (below) outlines the academic mindsets and learning skills and strategies components and highlights those that are prioritized in this study.

Given that “research efforts targeting self-control, grit, and related constructs have thus far been fractionated” (Duckworth & Gross, 2014, p. 5), the current study proposes a multifaceted approach to fostering grit by reinforcing or instilling beneficial academic mindsets and training necessary learning skills and strategies, both of which are hypothesized to be higher-order psychological resources underpinning both dispositional grit (trait level)

Figure 3.2

Prioritized Components of Academic Mindsets and Learning Skills and Strategies



Note. During feasibility testing, teachers initially discarded the self-affirmation module, but it was reinstated based on feedback from the pilot test. Conversely, the SMART goals module was removed following the pilot test and was excluded from the final Learning Skills and Strategies (LSS) intervention content.

and behavioral manifestations of grit (state level). To achieve this, the strategy was to integrate elements from *existing* social-psychological interventions targeting growth mindset, sense of purpose, personal values, social belonging (grouped under academic mindsets), as well as self-control, deliberate practice, and goal setting (grouped under learning skills and strategies). These elements were further developed, refined, and tailored in collaboration with students representing the target group and their teachers (Chapter 4) to create two novel, brief, web-based grit interventions: one focused on academic mindsets (AM) and the other on learning skills and strategies (LSS). Because no study has yet compared the effectiveness of different types of intervention content on both self-reported grit and objective success outcomes (a research gap identified in section 2.8.1), the AM and LSS interventions were implemented both independently and in combination. This approach aimed to uncover potential differences in effectiveness between these interventions and to determine whether their combined impact might, as hypothesized, surpass their individual contributions.

3.4 ‘Wise’ Interventions

Most existing interventions on academic mindsets (and some deliberate practice interventions) fall under the category of psychologically ‘wise’ interventions, which are specifically designed to change the meanings people ascribe to themselves, others, or their circumstances in targeted, theory-based ways. The label ‘wise’ is applied because such interventions are “*are wise* [privy] to specific underlying psychological processes that contribute to social problems or prevent people from flourishing” (Walton, 2014, p. 73). These interventions leverage three core motivations: the need to understand, to think well of oneself, and to belong. By altering certain meanings about e.g., intelligence and academic setbacks (growth mindset) or social adversities (social belonging), they can foster long-term, self-reinforcing positive change, particularly during periods like adolescence. For example, social-belonging interventions have reduced disciplinary citations among disadvantaged students, while growth mindset interventions have improved academic performance by reframing challenges as opportunities for growth (Goyer et al., 2019; Paunesku et al., 2015).

Wise interventions are characterized by five key principles: (1) altering specific meanings to promote change, (2) recognizing that meanings operate within complex systems, (3) fostering recursive cycles that sustain change, (4) ensuring methodological rigor through small-scale experiments before scaling, and (5) implementing interventions ethically. Strategies include direct labeling, prompting new meanings, saying-is-believing techniques, and active reflection exercises (Walton & Wilson, 2018).

Scaling wise interventions requires, first, “a deep appreciation of theory” (Walton &

Wilson, 2018, p. 638); second, adaptation to local contexts and specific populations; and third, effective delivery methods, such as developing online modules or training intermediaries like teachers. A review of social-psychological interventions in education found that even brief interventions (20-60 minutes), “have lasting effects because they target students’ subjective experiences in school, because they use persuasive yet stealthy methods for conveying psychological ideas, and because they tap into recursive processes present in educational environments” (Yeager & Walton, 2011, p. 267). Short-term or one-off experiments also offer the advantage of isolating “the active ingredients of behavior change” (Duckworth & Allred, 2012, p. 639) while remaining flexible and economical. However, wise interventions “are not magic” (Yeager & Walton, 2011, p. 293), and considerable care should go into deciding what kind of interventions to scale and how to deliver them.

In contrast, skill-building interventions targeting areas such as self-control or goal-setting do not necessarily follow the same ‘less is more’ logic and may well require practice and repeated exposure⁴⁶. A review of self-control and goal-setting interventions (Duckworth et al., 2018) has found that brief manipulations can have effects lasting up to six months, including improvements in academic outcomes (e.g., Duckworth et al., 2013), but longer-term impacts would likely require boosters over time. While implementing boosters for the LSS intervention was beyond the scope of the current project, students received postcards as tangible reminders to help them retain and apply the learned strategies at home. One postcard showcased ‘badges’ earned for each deliberate practice step—including ‘Focus 100%’, which encompassed the self-control module—while another featured the goal they selected as part of the MCII module along with the *if-then* plan they developed to overcome obstacles. Further details about the perceived usefulness of the postcards are provided in section 9.6.5, p. 233.

Altogether, this research adheres to the principles of wise interventions and meets the criteria for effective scaling by utilizing theory-driven methods, drawing on evidence-based intervention content, carefully tailoring this content to the local context (Germany) and the target population of middle school students, integrating online modules that are delivered as brief, one-off interventions, and rigorously pilot-testing all materials to ensure their pedagogical relevance and technical usability prior to scaling. Ethical considerations are central to the project, with a strong emphasis on respecting students’ agency and actively

⁴⁶ There is also evidence suggesting that training effortful inhibition of impulses through repeated practice does *not* lead to generalized improvements in self-control (Miles et al., 2016). However, the authors acknowledge that self-control training may be more effective when it emphasizes proactive avoidance of temptation rather than reactive inhibition. In alignment with this view, the self-control module in the LSS intervention focuses on teaching students *situation modification* strategies, demonstrating how such strategies (e.g., turning off the phone before studying) can be employed preemptively to reduce the chance of impulses arising or intensifying.

incorporating their feedback during the development, implementation, and evaluation phases.

3.5 Conclusion

This chapter has provided a comprehensive overview of the assumptions, psychological antecedents, and theoretical foundations guiding the proposed grit interventions. By synthesizing insights from existing research, it established that grit is a multifaceted construct shaped by inherited, contextual, and psychosocial intrapersonal factors. Drawing on models such as those by Farrington et al. (2012) and SRI International (2018), as well as findings on the psychological resources underpinning grit, it introduced a streamlined theoretical framework linking academic mindsets and learning skills and strategies to gritty behaviors and academic outcomes. Additionally, the chapter outlined the key AM and LSS components that serve as building blocks for this study's interventions and highlighted the importance of rigorous, theory-driven, and ethically implemented approaches tailored to specific populations and contexts. This foundation sets the stage for the next chapter, which explores the development phase of the project, including the design, feasibility testing, and usability testing of the grit interventions.

4 User-Centered Design and Usability Testing of a Web-Based Grit Intervention

As discussed in Chapter 3, psychological interventions in educational settings have garnered significant attention for their potential to create lasting positive impacts on student achievement. Research by Yeager, Romero, et al. (2016) highlights that self-administered interventions, particularly those that address students' subjective construals of their abilities, learning experiences, and relationships with teachers and peers, can promote motivation and enhance academic outcomes. These interventions do not typically rely on new instructional content but instead leverage psychological insights to alter students' self-concepts and beliefs about learning. This approach has shown promise in initiating positive, self-reinforcing behavioral changes that can improve students' academic trajectories over time (Walton, 2014; Walton & Wilson, 2018; Yeager & Walton, 2011).

A promising development in delivering such psychological interventions has been the shift towards web-based formats, which offer several advantages over traditional in-person methods. Web-based interventions can offer greater accessibility, allowing students to engage with content at their own pace and from any location, thus overcoming temporal and geographical barriers (Awang et al., 2024). They also support scalability, making it easier to reach more students without a proportional increase in implementation costs. A further benefit for scalability is that web-based interventions require minimal training, which reduces resistance from teachers and makes such tools more appealing to school administrators (Buzhardt et al., 2004). This ease of adoption allows for smoother integration into existing educational practices, facilitating broader implementation across schools. Additionally, digital platforms can support interactive and engaging multimedia content, such as videos, quizzes, and games, which can help maintain student interest and motivation (Hadjerrouit, 2010b). Web-based tools can also collect detailed learning data, allowing for personalized feedback and adaptive learning experiences, further enhancing their effectiveness.

Despite their potential, effective design and implementation of web-based psychological interventions remain challenging, particularly when scaling up from experimental settings to real-world classrooms (Buzhardt et al., 2004). The design must balance technical usability, which looks at the ease of interaction, and pedagogical usability, which focuses on whether the materials support learning objectives and are engaging for students (Hadjerrouit, 2010b). Addressing both aspects is critical for ensuring that interventions are not only user-friendly but also effective.

Web-based interventions—many of which target social-psychological processes or

promote health-related behaviors—share many similarities with other online learning tools⁴⁷. Both types rely on interactive elements and structured content to support learning by enhancing and guiding learners’ cognitive processes. In developing these tools, concerns such as user engagement, ease of use, and (cultural) relevance are paramount. When it comes to evaluating their effectiveness, common challenges include maintaining user engagement, ensuring user satisfaction, and demonstrating measurable improvements in learning outcomes (Awang et al., 2024; Dworschak et al., 2024; Hadjerrouit, 2010a).

Hadjerrouit (2010b) noted that the development of web-based learning tools has often been driven by technical and software specialists rather than educators or students. This lack of active input from end users—learners—during the design process can limit the relevance and effectiveness of these resources. Many of these challenges persist today, even as digital learning technologies have advanced. For example, the #TechOnOurTerms initiative, led by young people and featured in UNESCO’s Global Education Monitoring Report (2023), advocates for a more balanced, user-focused approach to technology integration in education. It stresses that digital tools should support, rather than replace, human interactions in learning and that their development should prioritize the needs and safety of learners. This initiative calls for equitable access, user involvement in technology design, and long-term impact assessments to ensure that technology serves educational goals effectively⁴⁸.

In this context, design thinking—particularly user-centered design (UCD)—provides a valuable framework for developing web-based interventions. Design thinking emphasizes understanding user needs and refining solutions iteratively based on their feedback. This process is well-suited for developing theory-driven psychological interventions because it combines theoretical knowledge with practical insights from users, helping to create tools that solve problems for “students facing a particular set of motivational barriers” (Yeager, Romero, et al., 2016, p. 375). UCD involves engaging end users, such as students, throughout the design process to ensure that the materials are relevant, usable, and meet their needs. In addition, involving teachers in the development process is vital for improving pedagogical usability. While UCD traditionally emphasizes technical usability, web-based interventions—like other digital learning tools—must also consider pedagogical factors such as intelligibility, added value, goal-orientation, interactivity, autonomy, or motivation (Hadjerrouit, 2010a).

⁴⁷ This catch-all term refers to a variety of resources such as educational software, e-learning tools / platforms, m-learning tools (using mobile technologies), internet-based training (IBT), computer-based instruction (CBI), edtech, virtual education, cyber-learning, web-based learning resources (WBLR), etc.

⁴⁸ For more information about the #TechOnOurTerms initiative, visit <https://www.unesco.org/gem-report/en/2024youthreport-call-action>

This study contributes to the nascent body of research on applying design thinking in the development social-psychological interventions. While past research has explored delivering interventions online without needing professional development (e.g., Paunesku et al., 2015; Yeager et al., 2014), methodologies for adapting materials that were effective in initial experiments to the specific needs of different student populations were lacking. Yeager, Romero, et al. (2016) began addressing this gap by combining design thinking principles with psychological theory to tailor existing growth mindset intervention materials for 9th-graders in U.S. public high schools. Building on their work, the current research employs a design-based approach to develop a novel two-part grit intervention for secondary school students in Germany. It offers a model for how user-centered design, integrating feedback from both teachers and students, can be used to (trans)adapt, refine, and pilot test intervention materials in real-world classrooms. This process aims to ensure both the technical and pedagogical usability of the grit intervention, ultimately aiming to create an engaging and effective web-based learning tool for students. As detailed in Chapter 2, enhancing students' grit through targeted school-based interventions offers a promising approach to improving academic performance and narrowing achievement gaps, particularly in educational contexts like Germany, where students from migrant or low socioeconomic backgrounds are at greater risk of underachievement. To the best of my knowledge, no intervention targeting grit exists for school students in Germany. This report aims to provide a comprehensive account of the development process for such an intervention.

The structure of this chapter and the presentation of key findings draw inspiration from studies focused on developing and/or evaluating web-based interventions, self-management tools, or e-learning resources in education and healthcare (Awang et al., 2024; Buzhardt et al., 2004; Dworschak et al., 2024; Grim et al., 2017; Hadjerrouit, 2010a, 2010b; Idrees et al., 2023; Yeager, Romero, et al., 2016; Yu et al., 2014). This approach aligns with established research practices, ensuring a clear and comprehensive presentation of the results.

4.1 Focus of the Present Investigation

The current study is part of a larger research project aimed at developing, implementing, and evaluating a novel two-part grit intervention in comprehensive schools in Bremen, Germany. This project unfolded in several phases. The *design phase* encompassed all steps from the theory-based development of initial intervention materials, through multiple rounds of content refinement, the creation of web-based prototypes, their redesign following a pilot test, and the finalization and implementation of the intervention. Alongside the design phase, a *feasibility testing phase*—featuring focus groups with teachers and students—and a

usability testing phase, which included the pilot test and its subsequent evaluation, took place. After finalizing the intervention materials, the *implementation phase* followed, with the quantitative results of the intervention's effects discussed in Chapter 8. Lastly, the *evaluation phase*, discussed in Chapter 9, was carried out approximately one year post-intervention, using qualitative data from student focus groups to provide context for the observed outcomes and to assess the relevance, effectiveness, and design of the grit-focused content. The mixed-methods research design for the broader project is outlined in Chapter 5. The current chapter focuses specifically on the findings from the design, feasibility testing, and usability testing phases (Fig. 4.1, p. 61). It concludes with a general discussion, synthesizing reflections from the testing phases and addressing limitations and implications for future research and practice.

4.2 The Design Phase

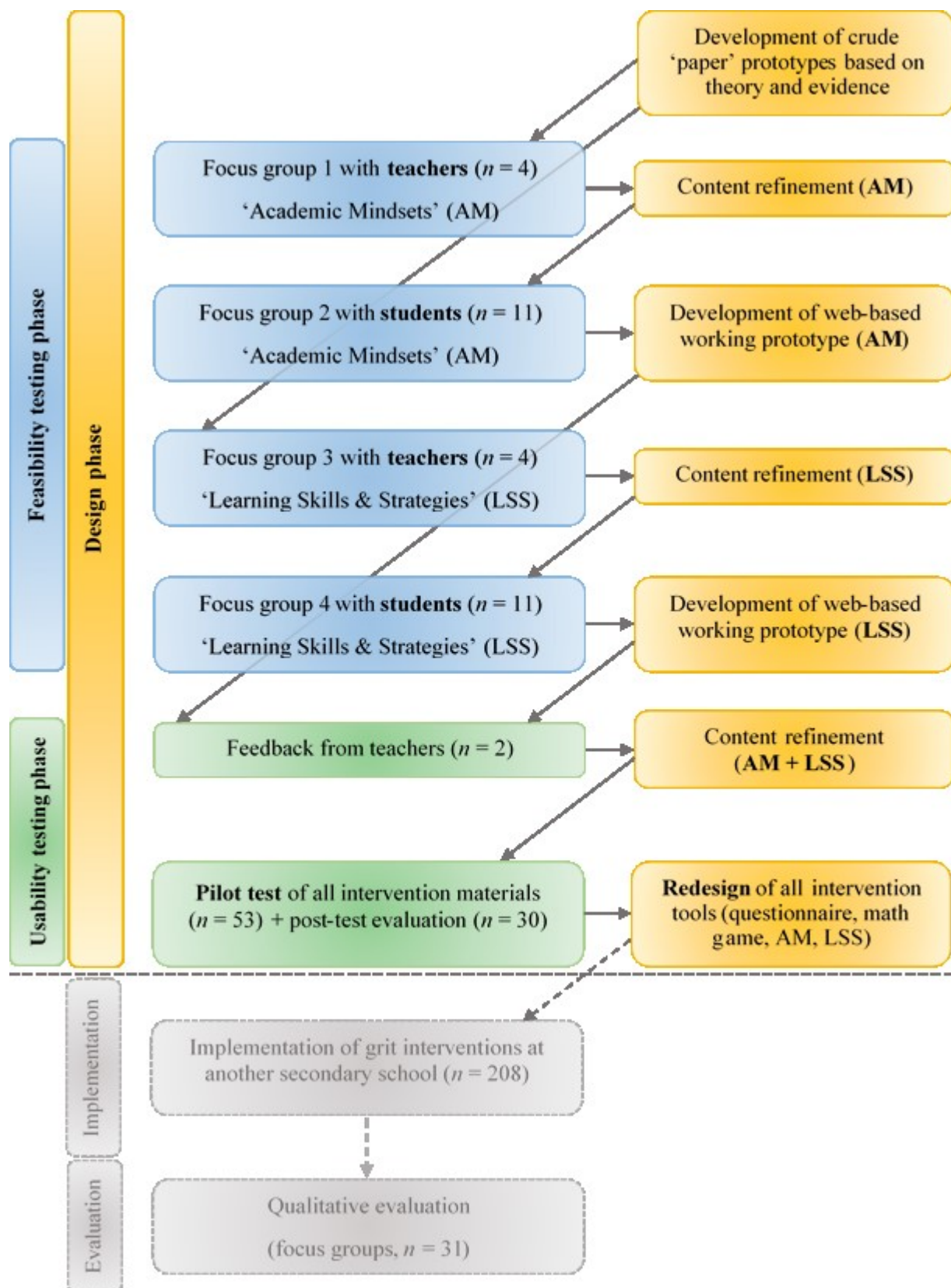
The hypothesized model of grit introduced in Chapter 3 posits that developing grit requires both the 'right' mindset(s) and the necessary skills and strategies needed to pursue and achieve valued goals. Specifically, in an educational context, these psychological resources can be understood as *academic* mindsets and *learning* skills & strategies. To test the theory-driven assumption that both elements are necessary for demonstrating gritty behavior—and that their combined presence would yield better outcomes—two distinct interventions were developed: one targeting academic mindsets and the other focusing on learning skills and strategies. This separation was essential to evaluate the distinct contributions of each component to a variety of outcomes (see Chapter 8). Throughout this study, these interventions are collectively referred to as a two-part grit intervention, two grit interventions, or two grit courses, with these terms used interchangeably.

4.2.1 Original Intervention Materials

The first step in the design phase involved preselecting original materials from existing social-psychological interventions that have effectively targeted changes in students' academic mindsets (AM) or instilled learning skills and strategies (LSS), leading to positive (academic) outcomes. From the AM literature—which covers beliefs about competence (e.g., self-concept of ability, self-efficacy, growth mindset), values and goals (e.g., attributional style, explanatory style, task values, academic goals, sense of purpose), and beliefs about social belonging and connectedness (SRI International, 2018)—materials from *growth mindset*, *social belonging*, *value affirmation*, and *sense-of-purpose* interventions were chosen. From the extensive body of research on learning skills and strategies (LSS), which includes self-regulatory skills (e.g., self-discipline, self-control, delay of gratification, emotional regulation) and learning strategies (e.g., study skills, deliberate practice, goal-setting, help-

Figure 4.1

Phases of Grit Intervention Development and Testing



seeking behaviors, time-management skills, metacognitive strategies) (Farrington et al., 2012; Snipes et al., 2012; SRI International, 2018), materials on *self-control*, *emotion regulation*, *deep practice*, and *two goal-setting strategies*—SMART⁴⁹ goals and MCII (*mental contrasting with implementation intentions*)—were preselected. The rationale for prioritizing these specific interventions over others within the same categories is detailed in section 3.3, while the sources of the original materials can be found in section 5.4.3. To complement the AM and LSS materials, a mathematical real effort task was also selected for adaptation. This task, which assessed students' willingness to retry a challenging addition game after failing, meant to serve as a behavioral measure of grit in addition to the ubiquitous self-report measure.

Starting with original, theory-based intervention materials that have been tested and proven effective is essential when adapting interventions for new student populations, as emphasized by Walton and Wilson (2018). The success of psychological interventions hinges on subtle nuances that can easily be overlooked or misunderstood. For instance, misinterpreting the concept of a growth mindset can lead to misguided practices, such as praising effort regardless of its effectiveness. Adapting or scaling up interventions requires a deep understanding of the targeted meanings and the techniques to modify them. Using validated materials as a starting point, rather than creating new ones, ensures the high-fidelity transmission of complex ideas, reducing the risk of misinterpretation during adaptation. Moreover, by understanding the specific context and needs of the new population, researchers can make adjustments that enhance the intervention's relevance while preserving its theoretical foundation.

Mindset interventions, most of which are psychologically 'wise' interventions—already introduced in section 3.4—aim to change meanings that may be detrimental to growth and well-being. They do this through various strategies to shift meaning-making, such as presenting new information (e.g., the idea that intelligence can be developed), asking leading questions, modifying situations, and encouraging commitment to new beliefs through action. A key example is the *saying-is-believing* technique, where individuals explain the concept to younger or less experienced peers using examples from their own lives, making the idea more personally relevant and memorable. Interventions might also ask people to actively reflect, often in writing, on positive aspects of themselves, negative experiences, or their core personal values, which helps remedy threats to self-integrity (Walton & Wilson, 2018). Most growth mindset and social belonging interventions follow a three-part structure: presenting

⁴⁹ The SMART stands for Specific, Measurable, Achievable, Relevant, and Time-Bound.

new information, providing success stories or prompting reflection on past achievements, and using a saying-is-believing exercise to promote active engagement with the new ideas, increasing the likelihood of self-persuasion as people align their beliefs with what they share.

Learning skills and strategies interventions are often referred to as person-centric interventions because they focus on addressing personal deficiencies or enhancing personal qualities, skills, or abilities—such as self-control—that benefit individuals across multiple life domains. Often, these interventions can (and do) also benefit from including elements that promote beneficial beliefs about effort, abilities, or one’s environment. When the goal is to build skills, practice and repetition are often necessary, resulting in dose-response effects. However, if the aim is to shift meanings, a single ‘dose’ may be sufficient to create lasting change by influencing a recursive process (Walton & Wilson, 2018). Skills and strategies interventions typically include information about the relevant skill, tasks or quizzes meant to reinforce the new knowledge, success stories or reflections on applying the strategy, and saying-is-believing exercises, where participants give advice to others who have not yet developed these skills, tapping into prosocial motivations.

4.2.2 Translation and Initial Adaptation

The manual for the MCII goal-setting strategy, also known as WOOP (Wish, Outcome, Obstacle, Plan), was available for download in German on a website⁵⁰ created by Prof. Dr. Gabriele Oettingen, the method’s developer. All other original intervention resources, either published as supplemental materials or provided directly by the researchers, consisted of English-language texts, images, animations, videos, tasks, quizzes, and writing prompts. All text-based materials were translated into German with the support of a graduate student assistant who is a native German speaker. Videos and animations remained in English for the initial focus groups with teachers. Those approved by the educators were later dubbed into German with the help of three native speakers, including a professional radio host, for use in student focus groups. Subsequently, all materials were adapted to suit the *expected* vocabulary and interests of the target population—7th- and 8th-graders at comprehensive schools in Germany. Additional suitable audio-visual materials, such as images, graphics, and German-language animations or videos related to topics like growth mindsets, were identified and incorporated. Finally, these components, collectively serving as rough ‘paper’ prototypes of the grit interventions, were compiled into two PowerPoint presentations: one for the AM intervention and one for the LSS intervention.

⁵⁰ For details see <https://woopmylife.org/de/practice>

4.2.3 Content Refinement

The iterative nature of user-centered design (UCD) meant that materials were revised and improved at each stage, based on concrete feedback from both teachers and students. Each grit intervention underwent four cycles of refinement, as illustrated in Figure 4.1 (p. 61). The first two rounds of revision occurred during the feasibility testing phase: an initial revision after the focus group with teachers and a second one after the focus group with students, leading to the creation of the first web-based prototypes. During the usability testing phase, a third round of minor revisions was made based on teacher feedback, followed by a fourth cycle of major adjustments informed by data collected during and after the pilot test. These iterations resulted in the intervention materials that were ultimately implemented and evaluated in the main study. The revisions were comprehensive, encompassing changes to structure, content, writing style, vocabulary, audio narration, images, and even formatting. The implementation of feedback from the focus groups and the pilot test is detailed in the Results sections for the feasibility and usability testing phases, respectively.

4.3 The Feasibility Testing Phase

4.3.1 Method

The feasibility assessment of the grit interventions began with focus groups involving teachers, one for each grit intervention, who provided feedback on the initial transadapted materials. This stage was akin to an expert review or a *heuristic evaluation*—a key method in usability testing—where experienced professionals describe the potential problems they foresee for users (Carvalho, 2001). The teachers' involvement was critical, as they offered valuable insights into both pedagogical aspects—such as content delivery, clarity, alignment with educational standards, and age-appropriateness—and the practical feasibility of implementing the materials in a classroom setting. Their feedback highlighted potential challenges related to student engagement and comprehension, which informed subsequent revisions of the material. Next, focus groups with Grade 7 and 8 students, who represented the target population, served as a *user-centered formative evaluation*, providing insights into students' preferences and revealing elements that would make the intervention more appealing and accessible. The active participation of students in this phase was especially noteworthy, as students rarely have a direct role in shaping or refining educational content, despite their unique understanding of what is engaging and relevant (Hadjerrouit, 2010b).

Participants. A comprehensive school in Bremen was the site approved by the

Ministry of Education for conducting the pilot study phase of the broader research project⁵¹. Four teachers from this school agreed to take part in the teacher (expert) focus groups, representing a convenience sample that was “available with regard to access, location, time, and willingness” (Lopez & Whitehead, 2013, p. 124). This sampling choice suited the study’s objectives, as the participating teachers were highly familiar with the school and the needs of the target student population. The sample size allowed for in-depth, context-specific feedback without the logistical challenges associated with recruiting additional external teachers.

The purposive sampling strategy used for the student (user) focus groups can be best described as a combination of typical case sampling and criterion sampling (Shaheen et al., 2019). Teachers selected 11 students who represented typical 7th- and 8th-graders, reflecting the school’s demographic, which includes a significant number of students with a migration background. An additional criterion was that students needed a sufficient command of the German language to understand and evaluate the intervention materials and to provide articulate feedback. They were also chosen based on their interest in contributing to the study, as involving students who were motivated to co-develop the interventions was essential for obtaining meaningful and constructive feedback.

Data Collection. Focus groups were used to gather feedback for the iterative refinement of the intervention materials because they offer several advantages over conducting multiple individual interviews. They can be less intimidating, particularly for younger participants who might feel uneasy in formal settings (Lopez & Whitehead, 2013). The group dynamic encourages participants to share thoughts that they might not express alone, fostering open discussion and the emergence of shared experiences (Breen, 2006). Another benefit is that group discussions can reveal areas of agreement and disagreement among participants, providing richer insights into the topic domain (Yu et al., 2014). Additionally, focus groups are more efficient than one-on-one interviews for gathering comparable amounts of data. This method is commonly used in applied research, particularly for specifying intervention stimuli or refining ‘manipulations’ of independent variables, as was the case in this study (Morgan, 1997). While individual interviews may explore topics in more depth, focus groups offer a broader range of perspectives, which was essential for understanding how teachers and students perceived the intervention materials.

The same interview schedule was used for both sets of focus groups: those with teachers and students discussing the Academic Mindsets (AM) intervention materials, and

⁵¹ The school consent form is provided in Appendix B.1, p. 316.

those focused on the Learning Skills & Strategies (LSS) intervention. The only difference was the specific content discussed during the sessions, tailored to each intervention's focus. This approach ensured a consistent process for collecting feedback across both expert and user groups, while allowing participants to address the unique aspects of each intervention. The schedule⁵² for the teacher focus group (AM version) can be found in Appendix D.1, p. 336.

The opening section of the interview schedule included an introduction round, the establishment of ground rules, and a brief overview of the entire project. This was followed by a detailed presentation of the main topics—four for the AM focus groups (growth mindset, social belonging, value affirmation, and sense-of-purpose) and five for the LSS focus groups (self-control, emotional regulation, deep practice, SMART goals, and the MCII goal-setting strategy). Participants were then asked to make opening statements on the intervention as a whole. The main section contained questions about content relevance and clarity (e.g., texts, videos, writing tasks), language, logical flow, course duration, intelligibility of the student questionnaires, and the concept and difficulty level of the math game. The interview schedule concluded with prompts for closing statements, allowing participants to reflect on their contributions, clarify their assessments, and offer any additional insights (Hallas, 2014).

User-centered design does not usually involve asking users what they want or find appealing, as they may not always be aware of these preferences (Yeager, Romero, et al., 2016). Instead, users are often better at identifying aspects they find confusing or problematic. For this reason, I did not directly ask participants—especially students—what would help them adopt a growth mindset or feel a sense of belonging. Instead, following the example set by Yeager, Romero, et al. (2016), I first asked teachers—and later, in the follow-up session, students—to review a ‘minimally viable’ version of each intervention, which included draft revisions of the original materials. I then guided participants to share what they liked, disliked, or found confusing. Additionally, in the student focus groups, I asked participants to summarize the interventions' messages in their own words. This allowed me to identify areas needing improvement, based on the assumption that inaccuracies in their summaries would indicate parts of the message that lacked clarity. The input from the teacher focus groups was used to refine the intervention materials for the subsequent sessions with students. The feedback gathered from the students was then incorporated into the development of the two web-based intervention prototypes (AM and LSS) that were used in the pilot test.

Procedure. The teacher who served as my primary contact at the school recruited

⁵² Please note that the interview schedule is written in German.

three additional teachers for the expert focus groups, as well as 11 students for the user focus groups, based on the criteria outlined in the ‘Participants’ section. All students were required to submit signed consent forms from their parents or legal guardians prior to their participation⁵³. The focus groups took place on the school premises in February and March 2019. Any students who had scheduling conflicts were formally excused from class to attend the discussions. Each focus group session lasted approximately 2.5 hours, was conducted in German, and was moderated by me. A native German-speaking graduate student assistant, who had previously assisted with translating and adapting the materials, typed detailed notes during each session. A teacher was also present during the student focus groups to provide support and create a familiar environment, which can reduce shyness, encourage a more open exchange, and enhance the quality of feedback provided by students (Adler et al., 2019).

At the start of each session, participants were briefed on the purpose of the discussion, and signed participant consent / assent forms were collected⁵⁴. An introduction round followed, during which the student assistant and I shared our first names, invited participants to address us informally, and explained the ground rules for group behavior. This step is particularly important for the *user* focus groups, as it helps students feel at ease and perceive the interaction with the moderator as less formal than their relationships with teachers (Adler et al., 2019). After closing remarks, participants were thanked for their time and contributions.

Data Analysis. In analyzing the focus group digital notes, I employed several key features of *qualitative content analysis* as outlined by Schreier (2014). This process involved developing a coding frame based on emergent themes, refining it by revising or merging similar subcategories and adjusting its structure, and systematically applying it to categorize the feedback from both teachers and students. Additionally, I present the findings in the form of tables, aligning with the use of text matrices in qualitative content analysis. These tables provide a structured way to display feedback from teachers and students, allowing for easy comparison between the groups. They also summarize all (sub)categories identified during coding, offering a basis for exploring patterns and relationships within the feedback.

However, I did not implement *all* aspects of the formal content analysis methodology. Given the relatively small amount of material, I went directly to the main analysis without a trial coding phase, applying the coding frame to all feedback at once. Moreover, I did not provide detailed definitions, positive examples, and decision rules for each category, nor did I conduct two rounds of coding to assess consistency. This streamlined approach was essential,

⁵³ The consent form for parents / legal guardians is provided in Appendix B.2, p. 318.

⁵⁴ Teacher consent forms and student assent forms are provided in Appendices B.3 and B.4, respectively, p. 319.

as my primary goal was to quickly summarize the feedback for use in refining the intervention content, often within a two-week timeframe. Such adaptations of data analysis methods are common in program development and evaluation, where the need for quick adjustments to intervention tools requires balancing thorough analysis with practical time constraints. This method retained enough structure for a systematic synthesis of the feedback while allowing me to rapidly identify key themes and areas for content improvement in the interventions.

4.3.2 Results

Feedback from focus groups with teachers and students for the AM and LSS grit interventions informed the iterative development of web-based intervention prototypes (see also Figure 4.1, p. 61). Five main categories of expert/user input emerged through content analysis: content selection, content modification, accessibility issues, content confirmation, and miscellaneous. *Content selection*, with five subcategories (core content blocks, modules, videos, tasks, examples), focused on identifying the most relevant and appealing materials from a range of theoretically-sound and empirically-tested options pre-selected by me. Teachers primarily led this macro-level approach to intervention development, basing their choices on criteria affecting the pedagogical usability of web-based learning tools, such as understandability, motivation (intrinsically motivating tasks and examples), and differentiation (alignment with students' age, development, and interests) (Hadjerrouit, 2010a). *Content modification* included 10 subcategories, such as 'rephrasing suggestions', 'adding examples/videos', and 'synonyms', aiming to make content shorter, clearer, more engaging, and grammatically correct in German. *Accessibility issues* addressed adjustments to visual and audio elements, like adding audio narration to support students with lower reading comprehension. *Content confirmation* encompassed all intervention elements vetted and approved by teachers and students, including modules, videos, tasks, examples, and images.

The following subsections provide a detailed analysis of the feedback and its implications for each grit intervention.

Academic Mindsets. Table 4.1 on p. 69 presents the focus group feedback on the AM content, organized across the five main input categories (horizontally) and by input source (teachers or students) vertically.

The teachers' key decision in the *content selection* category was to prioritize the sense of purpose intervention over the value-affirmation intervention, both of which belong to the *values and goals* category in the Academic Mindsets literature. Sense of purpose interventions help students connect their efforts in school to meaningful, self-transcendent goals, like contributing to their community (Yeager et al., 2014). This approach can enhance students'

Table 4.1*Categories Identified through Focus Groups with Teachers and Students – Academic Mindsets*

Categories	Topics	Teachers		Students	
		Examples	No.	Examples	No.
Content selection	Core content blocks	‘Sense of purpose’ better than ‘values affirmation’	1	–	
	Modules	Video (John Legend) better than text (teacher story)	1	–	
	Videos	‘J. Legend’ / ‘The school’	2	–	
	Examples	Goethe over Shakespeare ‘Cab drivers’ (out of three)	2	Shakespeare over Goethe Most fitting student quote	2
		Replace student quotes	2	Remove / replace student quotes	1
Content modification	Example / task suggestions	Adding tolerance as a value	1	Having a goal (Brainstorming task) Add a two-part task in the SOP part Add content summary before tasks	3
	Rephrasing suggestions	Various	4	Title the ‘saying is believing’ sections ‘writing task’	7
	Need to explain / clarify words	Talent (‘Talent’) Priorities (‘Prioritäten’)	2	Brain injury (‘Hirnverletzung’) Connections (‘Verbindungen’) Disposition (‘Veranlagung’)	3
	Add tasks	More interactive elements	1	–	
		Exclude certain elements	3		
		Shorten text	2	Shorten text	1
	Task / example modification	Include images / charts	1	Include images / charts	2
				Confirm anonymity	1
				Confirm spelling is not important	1
				Min. of sentences for writing tasks	1
				Contextualize examples	1
	Synonyms	Various	4	Various	16
	Typos		1	–	
	Orthography	–		Do not abbreviate d. h., u. a.	3
Accessibility issues	Visual elements	Spacing	1	Increase line spacing (in quotes)	1
		Subtitles	–	Add subtitles to a video	1
		Images	1	Images aid understanding	1
		Emphasis	–	Emphasize important words	1
	Audio elements	Music	2	Turn down music volume	1
		Voice	–	Narrator’s voice should be louder	1
		Narration	1	Most important for long texts	1
	Structure /sequence /prompts	Time	1	–	
			1	Time needed for writing tasks	1
		Pace	–	Pace of videos somewhat high	3
Miscellaneous	Materials	Pen and paper; headphones	2	–	
Content confirmation	Module / Video / Task Example / Image	Brainstorming task; ‘Neuroplasticity’ video; ‘Babies’ example; ‘Cab drivers’ example; ‘You can learn anything’ video; ‘Iceberg’ animation; ‘John Legend’ video; ‘Nonlinear success’ task; Personal success story; Letter example (GM); Saying-is-believing task (GM); Survey about school belonging; SB success stories; ‘The school’ music video; ‘Comprehension check’ task (SB); Saying-is-believing task (SB); Two writing tasks (SOP); Student motivation video; Student survey (SOP); Student future stories; Saying-is-believing (SOP); (Preliminary) visuals; Number of videos; Postcards with badges (Teachers: 20; Students: 24)			

Note. No. = Number; SOP = Sense of purpose module; d. h. = das heißt (that is), u. a. = unter anderem (among others); GM = Growth mindset; SB = Social belonging module

academic self-regulation and help them maintain their motivation during challenging or tedious tasks, which can boost achievement, especially for underperforming students (Paunesku et al., 2015). In contrast, value-affirmation interventions help students cope with (social-identity) threats by reflecting on core personal values, which fosters a sense of psychological safety that can improve academic performance and well-being (Walton & Wilson, 2018). Teachers believed that linking schoolwork to a broader sense of purpose would resonate more with students and positively influence their perception of school. Another key decision was to incorporate a ‘success through effort’ video featuring U.S. musician John Legend in the success stories module of the growth mindset intervention, instead of a text-based story featuring a fictional teacher. This choice not only enhances the module’s entertainment value but also likely increases its effectiveness. Research suggests that video-based content, for instance in computer-tailored interventions for smoking cessation, can be more effective than text-based content (Idrees et al., 2023). Students also contributed to the selection of content, choosing relatable examples and student quotes.

In terms of *content modification*, both teachers and students offered valuable suggestions for improving examples, tasks, and language, and for excluding elements that seemed unnecessary or difficult to grasp. Although teachers had already identified passages requiring rephrasing (4) and terms needing explanation (2) or replacement (4)—changes that were then implemented before the student focus group—students were especially active in proposing rephrasing (7 mentions) and simpler synonyms (16 mentions), ensuring language was clear and suitable for their age group. Notably, students also recommended adding brief content summaries before tasks, stressed the importance of mentioning anonymity and the irrelevance of spelling and grammar for writing tasks, suggested contextualizing student quotes by attributing them to anonymous peers in their school, and highlighted the need to adjust the delivery speed of videos for better comprehension.

Based on teachers’ preliminary feedback regarding *accessibility issues*, various adjustments were made to the student slides, such as adding images, increasing line spacing, and reducing text. Figure 4.2 (p. 71) illustrates the distinctions between the original teacher slides and the modified student slides. Students expanded on this feedback by requesting that key words be emphasized, subtitles be added to fast-paced videos, and audio levels be adjusted, such as lowering background music or clarifying narrations. The *miscellaneous* category included a single teacher suggestion—a reminder to ensure the availability of necessary materials (e.g., pen, paper, headphones) for the pilot test.

Learning Skills & Strategies. Table 4.2 (p. 72) presents the teacher and student focus

Figure 4.2*Accessibility Modifications: Teacher vs. Student Slides*

Slides for the Teacher Focus Group (AM)	Slides for the Student Focus Group (AM)
Teil 2: Erfolgsgeschichten Die Schüler lesen Kurzgeschichten von Schülern aus höheren Klassen, in denen sie ihre Erfahrungen beschreiben - die Herausforderungen, mit denen sie konfrontiert waren und wie sie sie überwunden haben, um dazu zu gehören und erfolgreich zu sein. Die folgenden Zitate wurden ausgewählt, weil sie die wichtigsten Ergebnisse der Umfrage widerspiegeln. „Die ersten Monate an der [Name der Schule] fühlte ich mich, als hätte ich einen Knoten in meinem Magen. Ich hatte Angst, mit meinen Lehrern zu sprechen. Ich kannte sie nicht und der Unterricht war schwieriger als der, den ich vorher hatte. Meine Sorge war, dass sie mich für dumm halten. Aber sie glauben an dich, selbst wenn du schlechte Zeugnisse bekommst. Sie möchten, dass du besser wirst. Mit ihrer Hilfe wurden meine Zeugnisse im zweiten Halbjahr besser. Die Lehrer an der [Name der Schule] sind für dich da.“	 „Die ersten Monate an der NOG fühlte ich mich, als hätte ich einen Knoten im Magen. Ich hatte Angst, mit meinen Lehrern zu sprechen. Ich kannte sie nicht und der Unterricht war schwieriger als der, den ich vorher hatte. Meine Sorge war, dass sie mich für dumm halten. Aber sie glauben an dich, selbst wenn du schlechte Zeugnisse bekommst. Sie möchten, dass du besser wirst. Mit ihrer Hilfe wurden meine Zeugnisse im zweiten Halbjahr besser. Die Lehrer an der NOG sind für dich da.“
Teil 2. Lese- und Schreibaufgabe Als Nächstes möchten wir mehr darüber erfahren, welche Art von Person Du werden möchtest. Was erwartest du von der Oberschule? Was für eine Person möchtest du sein? Umfragestatistiken zeigen, dass die meisten Schüler motiviert sind, in der Schule gute Leistungen zu erbringen, teilweise "um eine Karriere zu haben, die ihnen Spaß macht" oder auch "um einen Beitrag für eine bessere Welt zu leisten". Diese Statistiken werden von repräsentativen Zitaten begleitet (angeblich von Oberstufenschülern an der eigenen Schule), die die zentrale Botschaft unterstützen.	Was ist Dein Ziel? Als Nächstes möchten wir mehr darüber erfahren, wie Du Dich in der Zukunft siehst. Was erwartest Du von der Oberschule?  Warum lernst Du überhaupt?  Was motiviert Dich zu lernen?  Was für Ziele hast Du nach der Schule? 

group feedback on the LSS content, following the same format as the AM feedback table.

Because the LSS intervention focused on building practical skills rather than shifting mindsets, it included significantly more hands-on tasks and explanatory videos than the AM content, targeting skills needed for grit, such as self-control, deep practice (exercises designed to improve weaknesses and stretch current abilities), and goal-setting. For this reason, the teachers' contribution in terms of *content selection* was to determine which elements to retain or exclude. The emotion regulation materials, for instance, were considered overly complex for the age group and seen as excessive alongside the main self-control content, which emphasized strategies like situation selection and attention management to avoid distractions (Duckworth & Gross, 2014). Additionally, teachers felt that several videos, tasks, quizzes, and examples were either redundant or misaligned with students' needs or interests, such as a WOOP goal-setting video deemed "too American, too text-heavy, and unsuited for students".

In terms of *content modification*, teachers offered numerous suggestions for rephrasing and simplifying the material (71 mentions, compared to 8 in the follow-up student focus

Table 4.2*Categories Identified through Focus Groups with Teachers and Students – Learning Skills & Strategies*

Categories		Topics	Teachers		Students			
			Examples	No.	Examples	No.		
Content selection	Modules		Keep SMART goals	1	–			
			Remove emotion regulation part	1				
	Videos		Keep ‘The choice’ video	4	–			
			Remove ‘Deep practice’ video					
			Remove two ‘WOOP’ videos					
	Tasks		Keep various (interactive) tasks	13	–			
			Remove ‘WOOP’ quiz	2				
			Remove ‘Obstacles’ task					
	Examples		Choose ‘Minecraft’ over ‘snails’	6	Replace example about being good in school (SC)	1		
			Keep various examples	1				
		Remove ‘old man’ quote						
Content modification	Task suggestions	–			Eating healthy example (SC)	1		
	Rephrasing suggestions	Various	60		Reformulate task instructions	6		
	Need to clarify words	–			Transition between sections			
					Challenge (‘Herausforderung’)	2		
	Need to add examples / videos	Add examples for each goal characteristic (SMART)	1		Frustration (‘Frustration’)			
					Add examples for ‘Feedback’	4		
					Add examples for ‘Challenges’			
	Task / example modification				Add examples for ‘Plan’ task			
					Add videos			
					Exclude certain elements	2	Exclude certain elements	1
					Shorten text / sentences	4		
					Shorten task	3		
					Change text to interactive task	1		
					Contextualize example	3		
							Replace image for step 4 (DP)	2
							Modify image for ‘Minecraft’	
					Add explanation for a task	2		
Synonyms	Various	11	Various		2			
Typos	Various	3	Various		3			
Translation inaccuracies	Various	6	Various		1			
Access	Visual elements	Layout	Separate paragraphs clearly	1	–			
		Emphasis	Emphasize important words	1	Emphasize important words	1		
	Sequence / prompts	Time	Show task solution after 1-2 minutes of no activity	1	–			
Content confirmation	Module / Video / Task Example / Image	‘Choose challenge’ module: ‘Olympic training’ example; ‘Learning strategies’ writing task; ‘Beyoncé’ example; ‘Specific challenges’ sorting task; ‘Minecraft’ example; ‘Frustration tolerance’ content; ‘Comprehension check’ task; ‘Addition’ tasks; ‘Self-control’ module: ‘Self-control’ sorting task; ‘Writer’ example; ‘Cookie monster’ example; ‘The choice’ animation; ‘Which writer are you?’ quiz; ‘Find the distraction’ task; ‘Your learning corner’ task; ‘Saying is believing’ (SC); ‘Get feedback’ module: ‘Punctuation marks’ task; ‘Multiple-choice question’; DP finale: ‘Deep practice’ quiz + tasks; Student quotes (DP); ‘Saying is believing’ (DP); ‘Goal-setting’ module: ‘Identify strength / deficit’; ‘Positive goal’ task; ‘SMART goals’ module; ‘Run a marathon’ example; ‘SMART goal’ writing tasks; ‘Identify SMART goal’ task; ‘WOOP’ module: ‘Chocolate & fruits’ example; Postcards with badges (Teachers / Students: 35)						

Note. No. = Number; SC = Self-control module; DP = Deep Practice

group) and for correcting translation inaccuracies (6), aiming to improve clarity. They also recommended shortening certain text passages and making tasks more interactive, whereas the students focused on the need to *add more videos*, examples, and explanations for terms, tasks, or the four deliberate practice steps, to enhance understanding. Feedback from both groups supported the idea of providing students with a take-home postcard displaying the ‘badges’ they earned for completing each module. These cards are particularly valuable for the LSS course, as the skills and strategies it introduces require reminders and reinforcement to have effects on study behaviors and academic outcomes (Duckworth et al., 2018).

Overall Interpretation. In design thinking, particularly during the ‘ideation’ and ‘prototype’ phases, feasibility testing examines factors such as technological capabilities, user engagement, and alignment with end-user needs and expectations, providing actionable insights to refine prototypes. In the feasibility testing for the grit interventions, feedback from teachers and student focus groups shaped the intervention materials, ensuring they were not only theoretically sound but also relevant, engaging, and accessible to the target audience. Teachers often provided a macro-level perspective, suggesting major content adjustments and conceptual refinements, while students offered valuable insights into linguistic, contextual, and aesthetic suitability, ensuring the materials were comprehensible, meaningful, and visually appealing. This feedback guided the iterative refinement of the interventions, balancing fidelity to original theory-based techniques to shift meaning-making with age-appropriate presentation and engagement. The focus on simplification, rephrasing, and selecting relatable videos and examples underscored the importance of aligning the material with students’ developmental stage and the everyday realities of middle school in Germany.

Feedback Implementation. Following revisions based on feedback from the feasibility testing phase, I independently transferred the grit course materials to a web platform using the free H5P WordPress plug-in⁵⁵, which allows users to create videos enriched with interactive elements like quizzes, fill-in-the-blank tasks, and drag-and-drop exercises. Due to the limitations inherent in this nonprofessional approach, the process required approximately 300 hours within the period from March to April 2019, underscoring the considerable time and effort needed to create an interactive web-based intervention⁵⁶. Figure 4.3 (p. 74) illustrates the progression from an initial focus group slide to the final format of the same content within the interactive video, highlighting adjustments made for

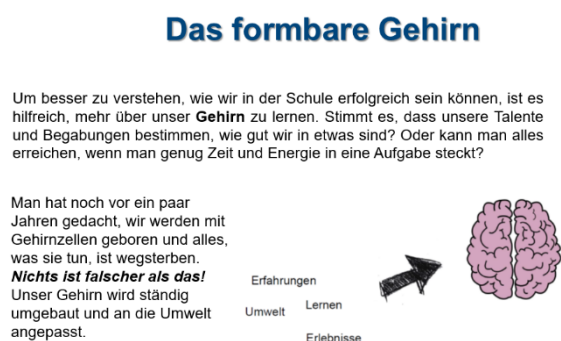
⁵⁵ For details about the H5P WordPress plug-in, visit <https://h5p.org/wordpress>

⁵⁶ While professional development of the web-based prototypes would have been ideal, constraints in resources and time placed this option outside the scope of the current project.

Figure 4.3

Evolution from Focus Group Slide to Interactive Video Format

Slide for The Student Focus Group (AM)



Web-based interactive video (AM)



Note. The brain illustrations in the web-based prototype are adopted from the *Growth Mindset* course on Khan Academy. All Khan Academy content is available for free at www.khanacademy.org

clarity, engagement, and accessibility in the web-based intervention.

I was fortunate to receive valuable assistance with other aspects of the project. An IT-skilled student assistant provided essential technical support, hosting the interactive grit videos on a server and managing the back-end configuration to ensure reliable functionality and accessibility for users throughout the study. He also integrated an open-source Learning Record Store (LRS)⁵⁷, designed to capture and analyze xAPI (Experience API) learning activity statements from the interactive videos, allowing for insights into learners' progress and performance. The student questionnaire, which included self-report measures on a range of psychological variables, along with the math game serving as a behavioral measure of grit, were programmed in PEARL by another colleague and hosted on the university server.

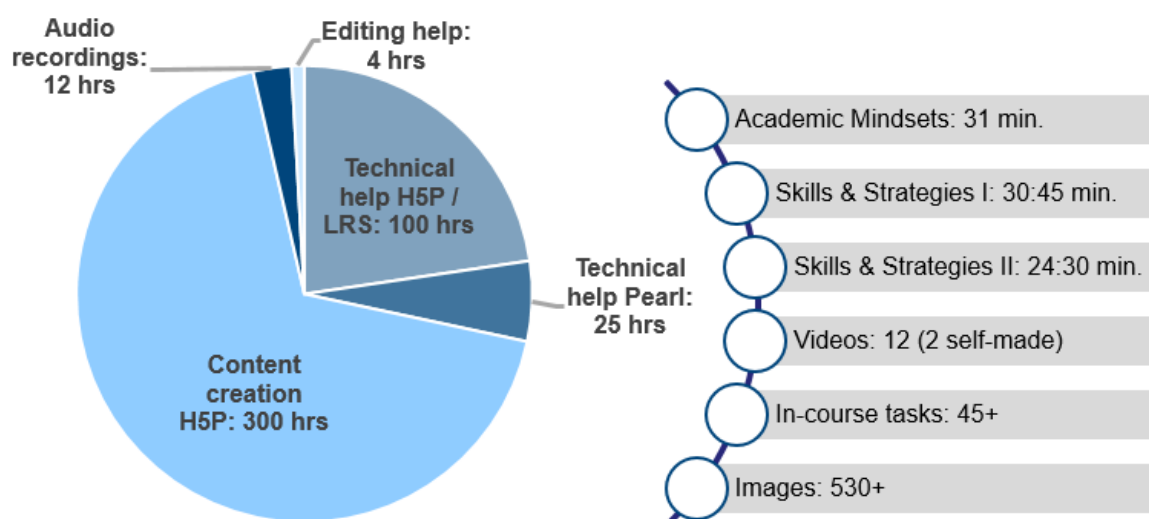
The AM content—featuring growth mindset, social belonging, and sense-of-purpose interventions—was incorporated into a single 31-minute interactive video. To provide students with a break and avoid information overload, the LSS content was divided into two parts. The first 31-minute video covered the initial steps of deep practice, 'choose challenge' and 'focus 100%', embedding the self-control intervention within the focus step. The second part, lasting 25 minutes, addressed the final steps of deep practice, 'get feedback' and 'reflect,

⁵⁷ At the time of this study, the Learning Record Store (LRS) was available as an open-source download (Learning Locker). It has since been incorporated into Learning Pool's portfolio of workplace e-learning solutions. For more details, see <https://learningpool.com/learning-record-store>

refine, repeat’, along with two goal-setting strategies. Based on student feedback, five additional short animations / videos were incorporated to illustrate the content better and make the LSS intervention more engaging. Figure 4.4 (below) presents the key technical setup statistics for the grit intervention working prototypes.

Figure 4.4

Technical Setup Statistics for the Grit Intervention Web-Based Working Prototypes



4.4 The Usability Testing Phase

4.4.1 Method

Prior to pilot testing the web-based working prototypes with students, they were reviewed by one teacher from the school hosting the pilot test and another from the school designated to host the main grit intervention. Teachers found that the prototypes were well-designed and effective in terms of technical usability. They also agreed that key dimensions of pedagogical usability—such as added value, understandability, goal-orientation, time, interactivity, multimedia use, motivation, differentiation, and autonomy (Hadjerrouit, 2010a)—were generally achieved. They recommended minor adjustments for clarity and usability, such as replacing the term *submit* on action buttons, repositioning these buttons for visibility, ensuring only relevant words are clickable in one task, and increasing line spacing in one text segment. These changes were subsequently implemented and the grit interventions underwent a *pilot test* with representative participants (7th- and 8th-graders from the same comprehensive secondary school), which served as a further form of usability testing.

This phase encompassed direct observation of students navigating the web-based

content, feedback collection through comprehension checks embedded in the self-report questionnaire as well as an online post-pilot usability survey, evaluation of their performance in a math game, and assessment of their understanding of the material via a written task. The aim was to evaluate the prototypes with target users to assess overall comprehension and acceptability, as well as to gather feedback on their content and form. Unlike traditional usability testing, which focuses solely on the technical aspects, this stage also considered pedagogical usability, ensuring that the materials were not only technically functional but also effective in fostering learning (Hadjerrouit, 2010a). Feedback from the pilot test informed further refinements, leading to a more polished and user-friendly intervention that was then implemented in a larger comprehensive secondary school in Bremen.

Participants. The usability testing phase involved a structured pilot test with 53 students from two Grade 7 and two Grade 8 classes at the school where the intervention materials were developed. Participating classes were selected based on logistical feasibility, with the added goal of comparing academic performance between pilot participants and non-participants from the two other classes in each Grade⁵⁸. Participation in the pilot study was voluntary, with students opting in based on interest and parental / legal guardian consent. Thus, the sampling strategy aligns most closely with *convenience sampling* with voluntary participation within a quasi-experimental design framework (Lopez & Whitehead, 2013).

To encourage the return of signed consent forms, regardless of whether parents agreed to the student's participation or not, the forms were provided in both German and Turkish to accommodate families with Turkish heritage, making the process easier for parents⁵⁹. Additionally, two 20-euro shopping vouchers were raffled after the pilot test among all students who had submitted a signed form. This approach yielded a sample size of 53 students, exceeding 50% of the invited population, which was deemed adequate since research indicates that 80% of usability issues can be detected with as few as four to five participants (Virzi, 1992, cited in Grim et al., 2017). This larger sample thus provided a robust basis for identifying a wide range of potential usability challenges.

Data Collection. To gain a broad understanding of the intervention's usability, two evaluation methods were employed: *static verification*, which included a) in-course performance metrics like task comprehension, completion rates, timing, and error frequency,

⁵⁸ Although this quasi-experimental design framework was implemented and pre- and post-intervention school marks were collected for both the pilot test participants and the non-randomized comparison group, analyzing this academic performance data falls outside the scope of the current doctoral project.

⁵⁹ The pilot test consent forms for parents / legal guardians are provided in Appendices B.5 and B.6, pp. 321-22.

recorded by the LRS⁶⁰, b) math game success rates, and c) quantitative data from a post-test usability questionnaire; and *dynamic verification*, consisting of direct observation of real-time interactions with the material and identification of usability issues. Teachers monitoring students in two computer rooms documented difficulties or questions that arose, complemented by my own observations. The dynamic verification process extends beyond observing participants' use of the instruments in controlled settings; it also evaluates the roles of teachers and schools in implementing educational / psychological interventions, while considering the broader integration of web-based learning within the educational system⁶¹.

Due to a technical malfunction with the LRS data capture, all in-course task completion and course evaluation data failed to record. To mitigate this issue, the self-constructed usability questionnaire was re-administered via Google Forms the following day. This questionnaire served as a diagnostic tool, collecting structured feedback from students on the practical usability, strengths, and weaknesses of the grit intervention prototypes. Initially drafted in English, the survey had been translated into German with assistance from two native speakers (see Table 4.3, p. 82, for the final English version). It included 14 multiple-choice questions covering topics such as course engagement (interest and enjoyment), perceived learning gains, personal relevance, anticipated future application, and feedback on the quantity of videos, images, text, writing tasks, and exercises. Additional questions addressed the suitability of course topics, examples, language, and pacing. An open-ended question invited students to share any content they found unclear.

Procedure. The pilot was conducted over an entire school morning in late April 2019 in two adjacent computer rooms, where students worked through the complete set of intervention materials: a 45-minute baseline self-report questionnaire on key psychological variables such as grit or school self-efficacy, a 30-minute math game, a 31-minute Academic Mindsets (AM) course, two Learning Skills & Strategies (LSS) sessions totaling 56 minutes, and the 15-item usability questionnaire embedded at the end of each course (AM and LSS).

Standard usability testing protocols—including participant greeting, orientation, running the pilot test, and debriefing—were implemented (Carvalho, 2001). Ethical guidelines were adhered to, with participants briefed on the study's purpose and reassured that task performance was secondary to providing usability feedback. Students were informed of their right to withdraw at any point. Informed assent was obtained digitally at the start of the first

⁶⁰ This technique is also known as software logging (Carvalho, 2001).

⁶¹ Static and dynamic verification are terms borrowed from usability testing (typically of software), that apply neatly to the evaluation techniques used here.

content block, after students reviewed information on data privacy and study procedures⁶².

Each room was supervised by a teacher who received guidance on handling any technical issues and used a standardized script to introduce the intervention (Appendix C.1, p. 330). Teachers observed participant interactions and recorded any usability challenges, while I moved between rooms, taking field notes and responding to content-related inquiries.

Data Analysis. For the *static verification of type (a)*, the self-report questionnaire featured two comprehension checks on each page: ‘Did you understand all the questions on this page? (yes/no)’ and ‘If not, please specify the question or words you found unclear: ...’ Responses were analyzed descriptively to pinpoint terms or questions in need of revision.

Additionally, one in-course task from the growth mindset module, the ‘saying-is-believing’ exercise, was handwritten on paper and remained unaffected by the LRS failure. In this task, students wrote letters offering advice to younger or less experienced peers who might struggle academically or feel ‘stupid’. These short texts were digitized with the help of a student assistant and analyzed for content alignment with the intervention. Thirteen categories of advice emerged, all reflecting key concepts from the lesson, such as the ‘importance of effort’ (e.g., you have to make an effort, learn more, work harder) and ‘everyone can improve’ (e.g., you can become smarter, you can learn new things). Each student letter was then rated based on how many of these 13 categories were used, from zero (no relevant content) to six (the maximum number of advice categories included by any student). The analysis aimed to assess how well students had understood the core messages of the growth mindset module and whether they could connect these messages to their own experiences, thereby personalizing and taking ownership of them.

For the *static verification of type (b)*, success rates were calculated across four rounds of the math game, where students had 90 seconds to find at least three pairs of numbers that add up to 100 within a grid. Students could choose either a small grid (easy game) or a large grid (difficult game), and the percentage of students who successfully completed the difficult game was determined. This analysis followed the guidelines provided by the original authors (Alan et al., 2019) and aimed to determine whether the success rate in the difficult game was optimal for differentiating gritty participants (i.e., those willing to attempt another difficult game despite previous failure) from less gritty peers.

For the *static verification of type (c)*, the post-test usability questionnaire results were analyzed descriptively, with additional nonparametric tests assessing how content and design

⁶² The text of the digital assent form is provided in Appendix B.7, p. 323.

features relate to students' enjoyment of the grit courses and perceived learning gains, as well as identifying significant differences in responses between the AM and LSS interventions.

For the *dynamic verification* through direct observation of participant interactions with the materials, field notes taken by the teachers and myself were analyzed to identify any technical or pedagogical usability issues requiring adjustment before the implementation phase. Specifically, these notes were reviewed to capture student difficulties with questionnaire items, challenges in understanding or navigating the math game, and any concerns related to engagement, pacing, and technical accessibility during the grit courses.

4.4.2 Results

Self-Report Questionnaire. Students reported difficulty understanding numerous words, including *previous*, *setbacks*, *discourage*, *focused*, *accept*, *intelligence*, *extent*, *required*, and *pursue*. Analysis of field notes further revealed that terms like *obsessed*, *achieve*, *pick up the pace*, *shape the future*, *comfortable*, *tend to*, *score well*, *accomplish goals*, and *continuously* also required clarification⁶³. Additionally, students struggled with a series of negatively worded questions on school engagement, such as 'In the last month, how often did you not pay attention in class?' (response options: never / rarely / sometimes / often / always). Lastly, when answering the question 'What vocational training / professional qualification are you aiming for?', students expressed confusion over some example professions listed as potential apprenticeship options after secondary school, such as carpenter, confectioner, nurse, and educator.

Saying-is-Believing Task. From the 53 students participating in the pilot test, 45 submitted letters they wrote during the growth mindset module (AM). Two indicators were used to evaluate performance on this 'saying-is-believing' task, both focused on students' ability to recall and integrate key content points in their letters. First, I applied a *threshold approach* where a score of 3 or higher (out of 6) was considered indicative of meaningful comprehension and application, as this score reflected the use of at least three distinct, content-relevant pieces of advice. This threshold aligns with a grade of 3 or 70% ('satisfactory') in lower secondary education in Germany⁶⁴. In my sample, 30 students out of 45 (66.66%) achieved a score of 3 or higher, suggesting that a substantial majority engaged with the material effectively.

⁶³ Please note these are English translations of the original words in German: vorherig, Rückschläge, entmutigen, fokussieren, hinnehmen, Intelligenz, Ausmaß, gefordert, anstreben, besessen, erzielen, das Tempo anziehen, die Zukunft gestalten, bequem, neigen, gut abschneiden, Ziele verwirklichen, durchgängig.

⁶⁴ A score of 6 on the 'saying-is-believing' task would correspond to 1+ (excellent), 5 would correspond to 1 / 1- (very good), 4 would correspond to 2+ / 2 / 2- (good), 3 would correspond to 3+ / 3 / 3- (satisfactory), 2 would correspond to 4+ / 4 / 4- (sufficient), and a score of 1 or 0 would correspond to 5+ / 5 / 5- / 6 (insufficient).

In addition to the threshold approach, an *average score method* was used to evaluate overall comprehension across the sample. Setting a target average score of 2.5 was deemed reasonable based on the assumption that students should be able to recall and use at least two to three concepts if they had effectively understood and engaged with the content. The actual average score of 2.88 exceeded this target, indicating that, on average, students were able to name and apply nearly three relevant pieces of advice. This dual approach—examining both individual achievement via threshold and overall comprehension via average score—provides a robust assessment of students’ performance, confirming both individual and collective accomplishment in grasping the growth mindset intervention’s messages.

Math Game. The math game comprised several rounds designed to reveal two indicators of gritty behavior: (1) whether students set an ambitious goal in a novel task, choosing between an easy or difficult game in the first round, and (2) whether they quit or persevere after experiencing failure(s) in the challenging task. The key metric for assessing grit is the success rate in the difficult game. A high success rate might lead most students to continue selecting the difficult game, thus obscuring true persistence. Conversely, if too few students succeed, the game may appear overly difficult, deterring even the grittier students from re-attempting it. According to the task’s developer, an optimal success rate falls between 10-15%: “Too much will prevent you from seeing the gritty students, too little will ... make persisting suboptimal” (S. Alan⁶⁵, personal communication, March 18, 2019).

In the current sample, success rates in the difficult game across rounds were markedly higher than intended, ranging from 60% to 78%. To increase task difficulty, I set up three alternative versions provided by the game’s author, using three-digit numbers that add up to 1000 rather than two-digit numbers adding up to 100: a 4x4 grid with 16 numbers, containing 4 matching pairs (least difficult), a 4x4 grid with 3 matching pairs (moderately difficult), and a 5x5 grid with 25 numbers and 4 pairs summing up to 1000 (most difficult). These modified grids were pilot-tested online two weeks later with a convenience sample of 34 students from a secondary school in Hannover, yielding success rates of ca. 65% for the easiest game, 41% for the moderately difficult game, and 17% for the most challenging game with the 5x5 grid. Hence, the 5x5 grid generated the success rate closest to the optimal level, suggesting it has a suitable difficulty for identifying grit-related behaviors in the implementation phase.

Additionally, field notes revealed that many participants skipped the math game

⁶⁵ Sule Alan, a Professor of Economics and Behavioral Science at Cornell University, USA, and Bilkent University, Türkiye, led the development of the math game task, which was first tested with a sample of 2,900 fourth-grade students in Istanbul, Turkey (Alan et al., 2019).

instruction pages—which included an example grid—by quickly clicking on ‘next’. As a result, some students struggled to understand the practice game and sought assistance. These findings suggest that the task could be improved by adding an audio recording of the instructions and making the ‘next’ button inactive until the audio concludes, ensuring students fully engage with the directions before proceeding.

Usability Questionnaire. The usability questionnaire data, summarized in Table 4.3 (p. 82), provide insights into areas such as engagement, perceived learning, personal relevance, practical application of content, frequency of elements like images, and the overall suitability of examples, language, and pace.

Most respondents ($n = 30$) found the grit interventions somewhat, very, or extremely interesting (AM: 83.3%, LSS: 73.3%) and rated them as somewhat or outright enjoyable (AM: 83.3%, LSS: 86.7%), with nearly 77% reporting they learned some, much, or very much in both courses. A notable majority also felt they had learned something personally meaningful (AM: 67.7%, LSS: 60%). Regarding anticipated future application of the course material, 50% to 66.7% were uncertain (‘don’t really know’), while 40% said ‘yes’ for the LSS course compared to 26.7% for the AM course. This discrepancy may reflect the LSS course’s emphasis on concrete skills, such as self-control and goal-setting, whereas the AM course focused on growth mindset, belonging, and a higher purpose for learning—(self-)views whose practical applications are less apparent to students. As Walton and Wilson explain (2018, p. 637), “a student who benefits from a wise intervention may attribute her success to her hard work and the effective teaching she received, and rightly so. It may be less apparent to her how her learning was also facilitated by a change in her interpretation of schooling”.

Regarding the frequency of specific content elements, such as images and tasks/games, between 66.7% and 76.7% felt the balance was ‘just right’, though 16.7% thought there were too few images, and 23.3% (LSS) to 26.7% (AM) felt there were too few tasks. For *writing tasks*, 56.7% felt the number was ‘just right’, while 36.7% reported there were ‘too many’ in both courses, suggesting that a notable minority would prefer fewer writing tasks. Field notes corroborated that students were often ‘lazy’ or ‘reluctant’ to type responses or handwrite the assigned letter offering advice to a struggling student.

In terms of video content (six in each course), most respondents felt the number was ‘just right’ (AM: 70%, LSS: 83.3%). However, 23.3% found the AM course had ‘too many’ videos, whereas none felt this way about LSS, with 16.7% instead saying there were ‘too few’. A more pronounced difference emerged regarding text, with 43.3% of students indicating there was too much text in the AM course, compared to 23.3% in LSS. This

Table 4.3*Usability Questionnaire Results for a Two-Part Grit Intervention (n = 30)*

Questions	Response options	AM	LSS
1. How interesting was this course for you?	Not at all interesting	0.0%	0.0%
	Not very interesting	16.7%	26.7%
	Somewhat interesting	36.7%	36.7%
	Very interesting	36.7%	20.0%
	Extremely interesting	10.0%	16.7%
2. Did you enjoy this course?	No	16.7%	13.3%
	Somewhat	43.3%	46.7%
	Yes	40.0%	40.0%
3. How much did you learn in this course?	Nothing at all	3.3%	6.7%
	Little	20.0%	16.7%
	Some	30.0%	33.3%
	Much	30.0%	30.0%
	Very much	16.7%	13.3%
4. Did you learn something important for you personally in this course?	No	33.3%	40.0%
	Yes	66.7%	60.0%
5. Will you apply what you learned in this course in the future?	No	6.7%	10.0%
	I don't really know	66.7%	50.0%
	Yes	26.7%	40.0%
6. What did you think of the number of pictures?	Too many	13.3%	6.7%
	Too few	16.7%	16.7%
	Just right	70.0%	76.7%
7. What did you think of the number of videos?	Too many	23.3%	0.0%
	Too few	6.7%	16.7%
	Just right	70.0%	83.3%
8. What did you think of the number of tasks / games?	Too many	6.7%	3.3%
	Too few	26.7%	23.3%
	Just right	66.7%	73.3%
9. What did you think of the amount of text?	Too much	43.3%	23.3%
	Too little	6.7%	13.3%
	Just right	50.0%	63.3%
10. What did you think of the number of writing tasks?	Too many	36.7%	36.7%
	Too few	6.7%	6.7%
	Just right	56.7%	56.7%
11. What did you think of the topics covered in this course?	Too difficult	0.0%	10.0%
	Too simple	16.7%	13.3%
	Just right	83.3%	76.7%
12. What did you think of the examples used?	Too difficult	10.0%	10.0%
	Too simple	3.3%	6.7%
	Just right	86.7%	83.3%
13. What did you think of the language used?	Too difficult	16.7%	3.3%
	Too simple	16.7%	10.0%
	Just right	66.7%	86.7%
14. What did you think of the pace at which the content was presented?	Too fast	13.3%	13.3%
	Too slow	26.7%	30.0%
	Just right	60.0%	56.7%

difference aligns with the AM-material's greater reliance on text for information delivery.

Finally, in terms of pedagogical usability—specifically, the perceived difficulty of topics, examples, and language, as well as the pace of content delivery—most students (ranging from 66.7% for AM language to 86.7% for AM examples and LSS language) felt that these elements were suitably challenging in both courses. However, more students found the AM course language either too difficult (16.7%) or too simple (16.7%) compared to LSS (3.3% and 10%, respectively). This may be linked to the greater reliance on text in the AM content, which could have amplified differences in students' reading comprehension skills. Most students felt the pace of delivery was appropriate, though a notable minority (26.7% for AM, 30% for LSS) found it too slow, while a smaller group (13.3%) felt it was too fast.

Given the paired nature of the data, statistical tests were selected to explore potential differences between the AM and LSS interventions. The Wilcoxon Signed-Ranks Test, assessing significant differences in the distributions of paired responses, was used for questions with ordinal answers that can be ranked, such as course interestingness and perceived learning gains. Results showed no significant differences for either course interestingness ($p = .317$) or perceived learning ($p = .366$) between the AM and LSS courses.

The Marginal Homogeneity Test was used for questions with more than two categories that could not be directly ranked (e.g., 'no', 'I don't really know', 'yes') to determine if the response distributions differed significantly between AM and LSS. Results indicated a significant difference in perceived language difficulty ($p = .025$), with the LSS course rated as having more accessible language. Differences for the amount of text ($p = .077$) and number of videos ($p = .109$), both discussed above, approached significance. For most other aspects (e.g., enjoyment, applicability, images, writing tasks), no significant differences were found, suggesting students generally perceived these similarly across both courses.

To compare yes/no responses to 'Did you learn something personally important in this course?', the Cochran's Q Test was used. Although typically applied to more conditions, it is also suitable for two paired conditions with binary outcomes. Results showed no significant difference ($Q(1) = 2.00, p = .157$) in perceived personal relevance between the courses.

Spearman's rank correlation analysis was used to explore relationships between questionnaire responses. This method is well-suited for ordinal data, capturing monotonic associations where higher ratings on one question align with higher ratings on another, even if the relationship is not linear. As a non-parametric test, it is also appropriate for data that may not follow a normal distribution. Only correlations between questions with compatible answer scales that allow for meaningful interpretation are reported.

For the AM intervention, there was a strong positive correlation between students' perceptions of how much they learned and their enjoyment of the course ($r_s = .747, p < .001$), indicating that students who enjoyed the content more also felt that they learned more. Importantly, these relationships do not imply causality; the reverse may also be true—students who felt they learned more might have enjoyed the course more as a result. Enjoyment was also strongly related to students' anticipated application of the acquired knowledge ($r_s = .646, p < .001$) and moderately related to interestingness ($r_s = .510, p = .004$), suggesting that those who enjoyed the course tended to find it interesting and foresee applying its content.

Several moderate to strong positive correlations emerged among content elements, such as images, videos, tasks, and text. Students who found there were 'too many' images tended to think there was, for instance, 'too much' text ($r_s = .500, p = .005$), while those who rated the number of videos as 'just right' felt similarly about, e.g., tasks ($r_s = .663, p = .001$).

Regarding content understandability and difficulty level, a moderately strong correlation emerged between language and examples ($r_s = .464, p = .010$), indicating that students who found the language too difficult also tended to find the examples too difficult.

For the LSS intervention, the positive correlations among interestingness, enjoyment, and perceived learning were even more pronounced than for the AM course, with all three coefficients above .730 ($p < .001$). Additionally, students who enjoyed the course were more likely to anticipate applying what they learned ($r_s = .650, p < .001$). Unlike in the AM course, few correlations among content elements (e.g., images, videos) reached statistical significance. The only moderate relationships observed were between writing tasks and tasks/games ($r_s = .445, p = .014$) and between writing tasks and text ($r_s = .409, p = .025$). In terms of understandability, students who found the topics too difficult also tended to report there was 'too much' text ($r_s = .489, p = .006$). Additionally, those who rated the pace as 'too fast' or 'just right' tended to have similar views about the difficulty of topics and examples ($r_s = .522, p = .003$, and $r_s = .537, p = .002$, respectively).

Across courses, direct pairing of identical questions (e.g., enjoyment in AM with enjoyment in LSS) resulted in significant positive correlations, with coefficients ranging from $r_s = .395$ ($p = .031$) for the amount of text to $r_s = .954$ ($p < .001$) for the pace of content delivery, indicating that students generally had a *consistent experience across courses*, particularly in terms of enjoyment, learning, and perceived importance. Interestingly, although the marginal homogeneity test indicated a significant difference in the distribution of responses for perceived language difficulty between the two courses, a weak-to-moderate, marginally significant correlation ($r_s = .318, p = .087$) suggests that individual students tended

to perceive language similarly across courses. In contrast, while the distribution of responses for topic difficulty was consistent across courses (nonsignificant marginal homogeneity test), the negligible, non-significant, and negative correlation indicates that students' individual perceptions of topic difficulty did not align between the two courses.

Overall, these results provide valuable insights into students' experiences with the grit courses, indicating that enjoyment and interest are closely tied to perceived learning outcomes. This underscores the role of stimulating content in fostering positive learning experiences. The consistency across both courses suggests that the structure and design elements resonated with students in similar ways. The positive ratings of interestingness, enjoyment, and learning indicate that both courses largely met instructional goals, with only minor refinements needed. These findings suggest that course design should maintain stimulating content while also addressing *language accessibility* and *text density* to optimize student experiences.

Dynamic Verification. Teachers' observations during the pilot, complemented by my field notes, revealed *content-specific challenges* and areas of disengagement among students. Key difficulties included the punctuation task within the 'Get feedback' step of deep practice (LSS) and the entire SMART goals module (LSS). Comprehension issues were also evident in the WOOP module (LSS), where students were tasked with selecting a goal, expressing it as a wish (W), envisioning the best possible outcome (O), identifying obstacles (O), and drafting a plan (P) to overcome these obstacles. Supervising teachers perceived the length difference between the AM course (31 minutes) and the LSS course (56 minutes) as an imbalance and found the LSS content too lengthy for a single school period. Additionally, the transition between the social belonging and sense-of-purpose modules in the AM course may have been somewhat abrupt, causing confusion for a couple of students who sought clarification. Observational data further underscored the need to simplify language, especially in the self-report questionnaire, condense text to sustain student interest, improve transitions and site navigation between modules, and reduce the writing load for certain tasks—all aimed at making the content clearer and more engaging for students.

Direct observations during the pilot test highlighted three main concerns related to *students' behavior and abilities*. First, maintaining discipline proved challenging. Despite instructions to complete the materials in silence, there was frequent chatter among participants, particularly when I left one room to assist in the other, even though a supervising teacher was always present in each room. Additionally, some students attempted to access other websites while working on the grit courses, despite knowing this was not permitted. The

occurrence of these behaviors indicates that teachers may not have fully internalized the importance of maintaining a quiet, distraction-free environment for optimal student focus⁶⁶. Second, students exhibited limited attention spans, insufficient for engaging with content for half an hour at a time—a challenge closely related to the issue of discipline. Third, students' reading and writing skills seemed weaker than anticipated based on prior feedback from the feasibility testing phase (i.e., teacher and student focus groups), potentially contributing to quicker disengagement (point 2) and more frequent disruptive behaviors (point 1).

In terms of the *technical setup*, various issues became evident as participants worked through the intervention materials, which, while minor when considered individually, could collectively have significant implications for the overall user experience. Students struggled with accurately entering the URL for the first part of the pilot test (tiny.cc/t13q5y), particularly with characters such as the forward slash, 'y' (which could be located under the 'z' key depending on whether the PC was set to EN or DE), and 'q', which some confused with 'g'. They also found it challenging to input their assigned six-character usernames and passwords, which were random combinations of lowercase letters and digits. These usability hurdles underscored the need for adjustments to simplify student access and login procedures.

Technical problems also extended to the reliability of school equipment. At the start of the pilot, several computers failed to boot, prompting both one of the teachers and me to lend our laptops to ensure all students could participate. Throughout the session, sporadic device freezing and crashes required system reboots, and internet connectivity was occasionally slow or unstable. Such difficulties were surprising given the school's reputation as a leader in digital education in Germany, selected to share its experience in the use of digital media for teaching and learning as part of a nationwide 'digital school' development workshop⁶⁷. However, these challenges reflect broader issues highlighted in the latest International Computer and Information Literacy Study (ICILS 2023), which found that a third of students in Germany still lack access to WiFi at school, and around four 8th-graders share one school device. These problems are particularly pronounced in schools facing challenging circumstances, which require significantly more support to address both pedagogical and technological innovations (Anders, 2024).

Lastly, technical usability issues likely stemming from insufficient server capacity, network size, CPU cores, and working memory (RAM) resulted in website freezing, video

⁶⁶ If this was indeed the case, it also suggests that I may not have effectively conveyed to the supervising teachers the importance of minimizing distractions during the pilot test.

⁶⁷ For more information, see <https://www.forumbd.de/projekte/werkstatt/> (in German)

playback glitches, and, most critically, the Learning Record Store's failure to capture in-course task data. This failure necessitated the emergency use of Google Forms for the post-test usability questionnaire. Although re-logging in typically allowed students to resume tasks from where they left off, these interruptions emphasized the need for a seamless, uninterrupted user experience to support cognitive engagement with the content.

The pilot test underscored also the essential role of *teacher and school buy-in* for the successful implementation of school-based interventions. While I was fortunate to have a good collaboration with the school and teaching staff, the experience underscored just how vital this support is for ensuring seamless operations and maintaining student commitment. Active teacher participation and effective monitoring can significantly reduce challenges and facilitate better outcomes. Additionally, thorough teacher training and clear communication from researchers and external partners help reinforce the significance of the teachers' role in the process. Although meaningful results can still be achieved with a well-designed intervention and strategic approach, having the full backing of instructors and school leadership greatly enhances student engagement and overall implementation success.

Feedback Implementation. The various types of feedback collected during the usability testing phase led to content and technical revisions meant to ensure that the final instructional materials are both user-friendly (technical usability) and effective in promoting student engagement and learning (pedagogical usability). Table 4.4 (p. 88) lists the key changes implemented based on findings from this phase.

To address issues identified in the self-report questionnaire, confusing or unfamiliar terms were explained, replaced, or removed, and two questions were rephrased to enhance understandability and ensure reliable responses. For the math game, an audio version of the instructions was recorded by a native speaker and integrated with the existing text to prevent students from skipping the instructions and to make the content more accessible for those who benefit from auditory input or struggle with reading comprehension. The game's difficulty was adjusted by expanding the number grid for the difficult level from 4 x 5 (20 numbers) to 5 x 5 (25 numbers) and using pairs of numbers adding up to 1000 instead of 100.

Revisions to the two grit courses were guided by insights from the post-pilot usability questionnaire and the dynamic verification. The LSS course was streamlined by merging its two parts and omitting the SMART goals module, which proved overly complex for this age group. A 'punctuation task' within the deliberate practice module was removed due to student aversion and a 'study strategies' writing task was eliminated to reduce the overall writing load. Additionally, the 'Which writer are you?' quiz within the self-control module was

Table 4.4*Changes in Response to Findings from the Usability Testing Phase*

Area needing improvement	Change implemented	Rationale for improvement
Content		
Modules	Added a 'Values Affirmation' module (including a reflection task) within the 'SOP' module (AM)	Ease transition to 'SOP' section
	Expanded the 'GM' module to explain neurons, intelligence, neuroplasticity; added content on 'not giving up' (e.g., tackle negative thinking) to the 'Personal success stories' section (AM)	Explain confusing concepts; reinforce core GM message
	Removed the SMART goals module + tasks (LSS)	Content too difficult
Writing tasks	Removed the 'Study strategies' writing task (LSS)	Lessen writing load
Tasks / Games	Added 'Personal struggles' self-assessment (AM)	More tasks / quizzes needed in the AM intervention
	Added 'Effective effort' self-assessment (AM)	
	Added 'Positive thinking' quiz (AM)	
	Removed the 'Punctuation marks' task (LSS)	Not relevant
	Removed the 'Which writer are you?' quiz (LSS)	Not relevant
Examples	Added an example about animals to 'GM' part (AM)	Add easy examples
	Added examples for short- & medium-term wish / outcome / obstacle / plan to 'WOOP' part (LSS)	Improve task comprehension
Questionnaire	Replaced words and / or rephrased questions	Understandability
Math game	Enlarged grid and used numbers that add up to 1000	Increase difficulty
	Added audio narration to the instructions pages	Improve grasp
Design		
Structure	Restructured the LSS courses	Ensure logical flow
	Partially restructured the AM course	Include new items
Format	Added narration to the 'Iceberg' animation (AM)	Accessibility
	Made text content more concise (AM + LSS)	Accessibility
	Added notecard for 'Positive goal' task (LSS)	Ease of retrieval
	Added postcard for the 'WOOP' strategy (LSS)	Tangible reminder
	Paper version of 'Saying-is-believing' (DP, LSS)	Boost commitment
	Paper version of 'DP' self-assessment (LSS)	Tangible reminder
Length	Lengthened the AM course from 31' to 38'	Alignment with LSS
	Shortened the LSS course from 56' to 48'	Alignment with AM
Technical setup		
Server / RAM	Moved the courses to a bigger server / network	Improve stability
MySQL	Wrote a shell script to restart the MySQL database	Prevent data loss
LRS	Re-installed & tested the LRS on the new server	Record course data
Links	Created TinyURL links without special characters	Facilitate log-in
Usernames / Passwords	Decided on self-generated usernames; fixed the umlaut problem; same password for everyone	Facilitate log-in
Functionality	Fixed 'Find the distractions' task (LSS)	Improve accuracy
	Fixed 'Mark the correct words' tasks (AM / LSS)	Improve accuracy
	Moved 'next', 'submit', 'back to course' buttons	Optimize navigation

Note. AM = Academic Mindsets; LSS = Learning Skills & Strategies; SOP = sense-of-purpose; GM = growth mindset, DP = deep practice; LRS = Learning Record Store

deemed irrelevant to the core objectives and failed to engage students, many of whom bypassed the answer page entirely. These adjustments allowed me to expand the WOOP module, incorporating examples of short- and medium-term goals along with corresponding outcomes, obstacles, and plans, so as to enhance task comprehension and the overall impact of the goal-setting intervention. These changes reduced the course length from 56 to 48 minutes. Moreover, I created take-home postcards for the WOOP module that allow students to document their goals and *if-then* plans during the LSS course. These postcards will serve as tangible reminders of their commitment and the strategies they chose to overcome obstacles.

The AM course was revised by including a short values affirmation module to create a smoother transition between the social belonging and sense-of-purpose content. Although teachers initially excluded this content during the feasibility testing phase, considering it potentially less effective than the sense-of-purpose materials (see p. 68), it proved to be a suitable preamble to the larger sense-of-purpose module. The task invited students to select one or two values from a list and briefly reflect on their personal significance. Including this content is unlikely to contribute to information overload, especially given that 16.7% of students indicated the AM course topics were ‘too simple’. To address feedback that some examples and language were ‘too difficult’ (10% and 16.7%, respectively), the growth mindset module was enhanced with simpler explanations and examples for terms like neurons, intelligence, and neuroplasticity. Moreover, content focusing on transforming negative thoughts into positive ones was added to the ‘personal success stories’ section, reinforcing the core growth mindset message. Lastly, in response to 26.7% of students expressing a need for more interactive elements, I added two short self-assessments on personal struggles in school and effective effort toward challenging tasks, along with a quiz to identify ways to transform negative thoughts into positive ones. These modifications extended the course duration from 31 to 38 minutes, creating better alignment with the LSS content.

Several format changes were also made to enhance accessibility, such as adding audio narration to an animation and making all text passages more concise. Additionally, measures were implemented to improve the ease of retrieving previously named goals for use in the WOOP module, ensuring students’ commitment to the ‘saying-is-believing’ exercise by moving it to a paper-based format, and supporting long-term retention of their weakest deliberate practice step and self-selected goal through take-home versions.

Finally, to address technical usability issues, the grit courses and the LRS were transferred to a university server better suited for handling this content, particularly the frequent real-time H5PxAPI requests essential for recording in-course task data. Additionally,

a dedicated script was implemented to restart the MySQL database automatically in the event of a crash, mitigating the risk of data loss. To streamline student login, TinyURL links without problematic characters were created, and a decision was made to allow students to generate their usernames (following set criteria) and use a universal, short password for accessing the content. Functionality improvements were also made to three in-course tasks where students had experienced difficulties clicking on specific words or objects, and button placement was optimized to enhance navigation.

4.5 General Discussion

The feasibility testing phase, which included teacher and student focus groups, provided several important insights, two of which are particularly noteworthy. First, participants were largely positive about the concept of a web-based grit intervention aimed at equipping students with tools to achieve their academic and personal goals. Second, they emphasized the importance of individualization, which aligns with literature identifying tailoring as a critical factor that enhances user engagement and mediates the effectiveness of web-based interventions (Dworschak et al., 2024).

The usability testing phase, involving teacher feedback on web-based prototypes, pilot testing of intervention materials, and post-test evaluations, yielded essential insights for enhancing the technical and pedagogical usability of the grit interventions throughout the design phase. Technical usability ensures seamless interaction with web-based content, while pedagogical usability supports effective learning. These elements are interconnected; improved technical usability reduces cognitive load, allowing students to allocate more resources to learning. Adapting both elements to meet the unique preferences of school-aged users is vital, as they differ significantly from adult users (Hadjerrouit, 2010b). For instance, students typically prefer simple, visually engaging designs with interactive features and sound effects, rather than dense, text-heavy content—a trend observed also within my sample. Designing web-based interventions, therefore, requires an agile, iterative approach that brings together diverse knowledge and skills while engaging end-users, such as students, as active contributors and evaluators to ensure that the intervention is suitably tailored.

However, the successful implementation and evaluation of web-based interventions within schools is also inherently tied to the educational context. While using theory-driven materials and tailoring the interventions are indeed essential, these efforts must be supported by a conducive environment. For these interventions to be effective, students should be sufficiently proficient in using digital tools such as computers, laptops, or tablets, and ideally, they should have prior exposure to e-learning so that interacting with web-based content is not

entirely new. Unfortunately, findings from the ICILS 2023 suggest significant challenges in this area. Between 2018 and 2023, there was a sharp decline in computer and information-related skills among German students, with over 40% now exhibiting *very low* proficiency in digital media use—an increase from 30% five years earlier. Among students in secondary school types other than the Gymnasium (such as the comprehensive schools in this study), this figure rises to 50%, highlighting substantial disparities in digital competence (Anders, 2024).

This evidence underscores that deficits in technology integration are not simply about gaps in teacher training or resources but reflect a combination of socio-economic inequities and ingrained cultural beliefs about pedagogy. Addressing these issues requires sustained, content-integrated technology use and effective pedagogical modeling, alongside substantial investments in foundational skills (reading, language, and learning skills), targeted support for disadvantaged students, and 1:1 digital equipment to ensure equitable learning opportunities in the digital age (Anders, 2024; Hadjerrouit, 2010a).

Furthermore, measuring the impact of psychological or educational interventions depends on schools' willingness to share student performance data, such as grades, and on teachers' participation in filling out evaluation forms and questionnaires. Standardized testing can further support objective assessments, as these measures are often more reliable indicators of student achievement than grades alone. Ultimately, a web-based intervention must be embedded within a supportive educational setting that offers the desired infrastructure and collaborative engagement for successful implementation and evaluation.

4.5.1 Methodological Considerations

This pilot study has several notable strengths, including its rigorous, theory-driven, and evidence-based approach to intervention development and systematic content refinement based on feasibility and usability data. The commitment to user-centered design (UCD) ensured that revisions were guided by the genuine experiences of students and teachers. Additionally, the extensive and sustained engagement with participants throughout each phase enhanced the trustworthiness of the findings by fostering authentic feedback. The research process also emphasized respect for student input, ensuring their voices were integral to the iterative refinement of the intervention.

Despite these strengths, several limitations must be acknowledged. First, using a convenience sample for pilot testing raised the possibility of self-selection bias, potentially resulting in a group that included more highly motivated students than a typical classroom, which could have curtailed the validity of the results. However, in all other aspects, the sample was representative of the target student population: 7th- and 8th-graders from a

comprehensive secondary school in Bremen, with a substantial proportion of students with migration background, some of whom do not speak German as their first language. This diversity contributed to a rich and relevant data set, instrumental for refining the interventions.

Another limitation lies, to some extent, in the fact that this study was part of a PhD project conducted by a single researcher, which restricted available resources and capacities. For example, in the absence of professional web content developers, I created the intervention prototypes with assistance from student assistants and a colleague skilled in IT. Although the final grit courses were functional and visually appealing, this nonprofessional approach may have impacted the technical quality and user experience. Future iterations should also account for how the courses appear on tablets and smartphones, as compatibility with these devices was not tested in the current version. Moreover, incorporating adaptive tasks that adjust in real-time to each student's understanding and pace would enhance personalized learning (Awang et al., 2024). Involving a larger research team in future studies could address most of these challenges. Time constraints were another limitation, as I had only one month to implement the findings from the usability testing before deploying the final version of the grit interventions with a larger student group in Bremen. This tight schedule may have limited the extent of revisions that could be made to optimize the intervention fully.

Technical issues during the pilot test were a further shortcoming. The LRS failed to record in-course task performance data, and post-test usability questionnaire results were lost. Although I mitigated this by disseminating a new questionnaire the following day, only 30 of the 53 participants responded. Ideally, usability testing would also involve trained observers and multimedia tools (e.g., video/audio recorders) to capture user interactions, ensuring more reliable data. To prevent such issues from recurring during the main implementation phase, I transferred the LRS and grit courses to a more reliable university server, optimized system configurations, and implemented automated solutions to address potential server downtime.

Lastly, while I collected pre- and post-intervention school marks for pilot participants, testing whether the revised intervention materials were more effective than the piloted ones at enhancing grit and / or improving academic outcomes lies outside the scope of this project. This type of comparative analysis, as demonstrated in the work of Yeager, Romero, et al. (2016), could be explored in a future study to validate and expand upon my findings.

4.5.2 Conclusions and Implications for Practice

In developing a two-part grit intervention, this study employed a UCD approach involving multiple stages of feedback and fine-tuning to create materials that are both theoretically sound and relevant to the target audience. This approach is rooted in design

thinking principles, which prioritize problem-solving through continuous refinement based on real-world feedback (Yeager, Romero, et al., 2016). The feasibility testing phase, which included focus groups with teachers and students, incorporated both expert and user perspectives to ensure the materials were engaging, practical, and aligned with the needs of middle school students in Germany. Insights from final teacher reviews, the pilot test, and the post-test usability questionnaire—all integral parts of the usability testing phase—guided revisions aimed at making the web-based courses user-friendly and effective in fostering the academic mindsets and learning strategies likely needed to enhance students' (school) grit.

By offering a step-by-step account of the interventions' development process, this study serves as a resource for future psychological and educational intervention research and practice. Detailing the entire cycle—from conceptualization to testing and refinement—not only emphasizes best practices but also bridges the gap between theory and real-world application. This transparency is important for fostering continuous improvement and facilitating the broader dissemination of effective interventions (Dworschak et al., 2024).

Scalability is crucial for maximizing the reach and impact of *web-based interventions*. As prior studies note, an inability to scale these interventions can limit their benefit to the target student population (Buzhardt et al., 2004). According to Walton and Wilson (2018), scaling wise interventions, such as the Academic Mindsets one, involves understanding the techniques needed to modify meanings and beliefs, being able to adapt the content to the specific setting and population, and ensuring reliable methods for large-scale delivery—all of which were important to the present study. However, elements such as content relevance and user interface design are also pivotal in shaping their effectiveness. Usability testing is especially critical in this context, as it identifies potential barriers to student understanding and engagement, while also highlighting practical factors that support scalability (Awang et al., 2024). This study's documentation of the challenges encountered and solutions applied during the development and pilot testing of a web-based grit intervention provides a roadmap for those aiming to implement or adapt similar interventions in diverse educational settings.

5 Method

This chapter outlines the research design and methodologies employed in the *implementation* and *evaluation phases* of this doctoral research, in which targeted interventions for fostering grit in secondary school students were carried out and evaluated, with the ultimate goal of empowering students to reach their full potential.

A mixed methods approach, specifically a sequential explanatory design, is used to investigate both the general effects of the grit interventions and the nuanced factors that influence their outcomes. The research is conducted in two main strands: a quantitative strand, consisting of a school-based quasi-experiment, and a qualitative strand, involving focus groups with selected students to gain deeper insights into the quantitative findings.

Although the primary focus of the quantitative strand is the longitudinal analysis of the interventions' effects, it begins with a cross-sectional analysis of pre-intervention data collected at Time 1. This initial analysis, conceptualized as a *standalone cross-sectional study*, addresses RQ 1 and 2a-d by exploring the relationships between domain-general and school-specific grit, related constructs, and students' school marks prior to the interventions.

Following this cross-sectional analysis, the research proceeds to the longitudinal examination of the interventions' effects, which forms the core of the quantitative strand. The integration of these findings with the qualitative strand—where focus groups explore the experiences of students who either improved or stagnated/worsened academically—provides a comprehensive understanding of the factors influencing academic success in this sample.

The remainder of this chapter outlines the main study's design, population and samples, sampling strategies, instruments, procedures, analytical approaches for both strands, as well as key methodological and ethical considerations.

5.1 Tackling Design Limitations

The gaps in the literature on grit guide the selection of a population and sample, as well as the choice of research design. In addition to the theoretical and geographical considerations listed in section 2.8, the favored model ought to make amends for some of the *design and measurement weaknesses* apparent in existing research.

Many studies on grit are characterized by range restriction due to samples characterized by high performance or low dropout rates, which may exhibit less variation in grit than the general population (Credé et al., 2017), as well as insufficient contextual, familial, racial / ethnic, or class-based variation. This limitation underscores the need for grit research to include more diverse samples to better capture the full range of variability in grit

and its relationship with (academic) outcomes across different contexts and populations⁶⁸.

The need to conceptualize and measure grit also as a domain-specific construct—in addition to its prevailing conceptualization as a global or domain-general construct—was already conveyed by Duckworth and her colleagues more than a decade ago (e.g., Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). However, only a few studies have explored the domain specificity of grit in various contexts, such as secondary education (Clark & Malecki, 2019; H.-H. Lim & Cho, 2018; Lin et al., 2024; Schmidt et al., 2019)⁶⁹, higher education (Waldrop et al., 2024)⁷⁰, athletics and tertiary academic performance (Cormier et al., 2019; Mosewich et al., 2021), second language (L2) learning (e.g., Sudina et al., 2021; Teimouri et al., 2022), physical education (Guelmami et al., 2022), teaching (Baraquia, 2020), and clinical nursing (Park, Lee et al., 2020).

A further conceptual and measurement drawback is that most existing designs, if not all, are concerned only with objective achievements, such as GPA or retention, taking for granted individuals' commitment to the measured outcomes and failing to assess, in addition, grit's impact on *subjective goals* (Duckworth et al., 2007; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). Since grit involves passion and persistence in the pursuit of goals, it may be most important for self-selected goals that are narrower in scope than broad outcomes such as school success (Ivcevic & Brackett, 2014). Likewise, many studies focus on just one or two objective outcomes, such as test scores, and rarely evaluate multiple outcomes within a particular setting.

Moreover, as several researchers point out, there have been extremely few studies investigating medium- or long-term variation in grit, either in the absence of willful interference or, conversely, as a result of targeted interventions⁷¹. This limitation extends also to studies that examine the link between grit and various (academic) outcomes, as Steinmayr et al. (2018) rightfully observe⁷². The reliance on cross-sectional studies in the grit literature restricts the ability to draw causal inferences and understand the temporal dynamics of the relationships between grit and various success outcomes. The dearth of longitudinal data is

⁶⁸ See section 5.8.1 in the current chapter for an additional example of range restriction in the grit literature.

⁶⁹ In Spain, Postigo et al. (2021; 2020) also developed a 5-item academic grit scale. Prior to that, Rojas et al. (2012, cited in Adams & Khojasteh, 2018, Bozgün & Akın-Kösterelioğlu, 2021, Peker & Cengiz, 2023, and Temel et al., 2023) had also developed a 10-item academic grit scale, but this source is not available.

⁷⁰ Renshaw & Bolognino (2016) developed a College Student Subjective Wellbeing Questionnaire, which included two items from Grit-S, adjusted to fit an academic context.

⁷¹ See Park, Kwak, et al. (2020) and Zhang et al. (2024) for two recent examples of longitudinal studies involving grit.

⁷² See Buzzetto-Hollywood and Mitchell (2019) and Postigo et al. (2021; 2020) for rare examples of longitudinal studies investigating the link between grit and student performance.

also true for work that focuses on the long-term impact of psychological interventions on educational outcomes, though some research has shown that brief interventions may have lasting effects (Yeager & Walton, 2011).

Looking specifically at *intervention research* (presented in section 2.6, approximately three-quarters of studies examining the impact of interventions on grit or grit-related outcomes lack a control group, whether active or passive, and do not employ randomization at the individual or group level. Incorporating control groups and randomization is essential for enhancing internal validity, establishing causality, and isolating the true effects of grit interventions. Rigorous designs help clarify the mechanisms behind grit-related changes, strengthen the evidence for intervention effectiveness, and support the development of reliable, scalable interventions.

Finally, the near absence of mixed-methods designs and participant-centered evaluations in prior intervention studies limits our understanding of why and how interventions succeed or fail, hindering the development of more effective grit interventions. Concluding statements like “the growth mindset intervention did not have a significant effect on grit” (Burgoyne et al., 2018, p. 28) leave critical questions unanswered: Was the content conceptually or qualitatively unsuitable for fostering grit? Did it fail to resonate with participants, was it quickly forgotten, or did it not sufficiently inspire students to exert effort? Many of these questions could be addressed through qualitative follow-ups designed to clarify and contextualize quantitative findings.

The aforementioned shortcomings highlight the need to increase sample diversity, investigate grit’s domain-specificity, consider the role of the performance domain (e.g., task type or setting) in the grit-achievement relationship, assess multiple outcomes, examine both variations in grit and grit’s link to success in a longitudinal context, employ more rigorous study designs in intervention research, evaluate the long-term impact of grit interventions on personal and academic outcomes, and integrate qualitative evaluations to explore participants’ subjective experiences. This study seeks to address these gaps, providing a more holistic understanding of grit’s role in fostering personal growth, academic performance, and educational attainment.

5.2 Research Design

In order to address the objectives of the implementation and evaluation phases—carrying out and evaluating targeted grit interventions, examining their varying effects based on student characteristics, and exploring the underlying behavioral mechanisms through which grit and the interventions influence academic outcomes—a mixed-methods approach

was chosen. This approach is used widely in social and behavioral research as it combines the strengths of both quantitative and qualitative data, which, when used separately, may fail to capture the complexity of the research problem (Ivankova et al., 2006). A *sequential explanatory design*, one of the most popular mixed-methods approaches, was used to first assess the intervention outcomes quantitatively and then deepen understanding through qualitative insights. Despite its popularity, this design is not without challenges. Researchers must carefully consider the weight given to each strand, the sequencing of data collection and analysis, and the stages at which the findings of the strands are integrated, ensuring that the two types of data complement each other well throughout the study (Ivankova et al., 2006).

The quantitative strand of this research, which constitutes the implementation phase and addresses RQs 1 through 6, takes **priority** in the sequential explanatory design, which is typical for this approach. The first part of this strand (RQs 1 and 2a–d) employs a *cross-sectional quantitative design* to investigate the relationships between grit, its components, and a range of associated constructs, as well as their collective and individual contributions to students' school performance, measured by end-of-term Grade Point Averages (GPAs). Data for this cross-sectional study were collected at Time 1 (pre-intervention) via a self-report questionnaire, providing a snapshot of students' domain-general and school-specific grit, along with conscientiousness, school-specific self-control, academic self-efficacy, implicit theories of intelligence (mindset), school belonging, and school engagement. By incorporating school grit, the study addresses a previously identified weakness related to grit measurement. Although this design offers important insights into how these constructs operate within grit's broader nomological network and in relation to academic achievement, its nature precludes causal interpretations. To mitigate this, the cross-sectional study (Chapter 7) is complemented by a subsequent quantitative inquiry to examine changes and potential causal mechanisms.

The second part of the quantitative strand (RQs 3a–g, 4, 5, and 6) is a *cluster-randomized controlled longitudinal field quasi-experiment with mixed-design features*. *Cluster-randomized* indicates that entire school classes (clusters) were randomly assigned to different conditions; *controlled* implies the presence of a control group; *longitudinal* refers to the repeated collection of data from the same participants over a prolonged period of time; *field* specifies that the study was conducted in a real-world, non-clinical setting (school); *quasi-experiment* clarifies that the study is not a true experiment due to the lack of random assignment at the individual level; and *mixed-design features* points to the combination of pretest-posttest control group design (for self-report measures), posttest control group design (for self-selected goals, teachers' evaluations, and educational attainment), and interrupted

time series design, also known as quasi-experimental time series analysis, which involves collecting data at multiple and (ideally) equally spaced time points before and after an intervention (for students' half-year GPAs).

More specifically, the design includes three experimental groups and one control group. The experimental groups receive either (1) a grit intervention focused on developing Academic Mindsets (AM), (2) a grit intervention targeting Learning Skills and Strategies (LSS), or (3) a combined condition (AM + LSS) in which the two interventions are delivered to the same group in consecutive weeks. The control group receives no intervention but completes self-report questionnaires at the same pre- and post-intervention time points as the experimental groups. This setup was informed by the hypothesized model of grit (see section 3.3), which posits that demonstrating gritty behavior in an educational context requires both the 'right' academic mindsets and the skills and strategies necessary to achieve valued goals. By separating the two intervention components and including a combined condition, the study aims to evaluate both the distinct and combined contributions of these psychological resources to key outcomes, while also testing the assumption that their integration yields superior results compared to either component alone or the absence of intervention.

This longitudinal study (Chapter 8) examines the effects of the grit interventions on a wide range of outcomes over time. The *dependent variables* (DVs) include self-reported measures of domain-general and school-specific grit, alongside other constructs such as mindset and school self-control, assessed both pre-intervention (Time 1) and eight months post-intervention (Time 2). Additional DVs were the achievement of self-selected personal and academic goals, school grades tracked over two and a half school years, teacher assessments of students' academic progress three months post-intervention, and students' educational attainment measured five years post-intervention. By incorporating these diverse outcomes, this study addresses key shortcomings in prior grit research, such as the limited consideration of how grit functions across different performance domains, the lack of longitudinal data on grit's variability and its relationship with success, and the scarcity of evidence regarding the long-term effects of grit interventions on personal and academic trajectories. Furthermore, the analyses explore which intervention components are most effective, identify the students who benefit the most, and uncover the mechanisms driving the impact of grit interventions on academic outcomes.

The quantitative strand is complemented by a follow-up qualitative inquiry (Chapter 9) into the nature of the grit-performance relationship, which constitutes the *evaluation phase* of the broader research project. True to the sequential explanatory design, the qualitative data

collection was informed by the preliminary outcomes of the quantitative intervention study. Based on those findings, students were grouped according to their academic progress—whether they had improved or stagnated/worsened after the intervention. To gain a deeper understanding of how the intervention affected students, I selected participants from both Grade 8 and Grade 9, ensuring representation of both academic trajectories. This resulted in four focus groups: Grade 8 (improved), Grade 8 (not improved), Grade 9 (improved), and Grade 9 (not improved).

The focus group discussions explored students' attitudes toward school and learning, their study habits, their perceptions of the grit-focused content, and their feedback on the intervention design. The goal was twofold: first, to identify behavioral mechanisms that contributed to students' success and pinpoint elements of the interventions that were particularly motivating; and second, to uncover any missing behaviors or ineffective content that may have hindered progress. Subtle differences in how students absorbed, processed, and acted on the information—especially as some groups benefited more than others—can only be revealed through direct conversation. These qualitative insights help clarify how students' mindsets and behaviors may have influenced their academic outcomes, while also offering a comprehensive evaluation of the interventions' effectiveness.

In line with the sequential explanatory design, the integration of the quantitative and qualitative strands occurred at three key stages: in the beginning, when both strands were considered in formulating the study's objectives and research questions (Chapter 1 and 2); at the intermediate stage, when the results of the quantitative analysis informed the selection of participants for the qualitative follow-up (Chapter 9); and finally, at the interpretation stage (Chapter 10), when the quantitative and qualitative findings are synthesized to provide a more comprehensive understanding of the intervention's effects (Ivankova et al., 2006).

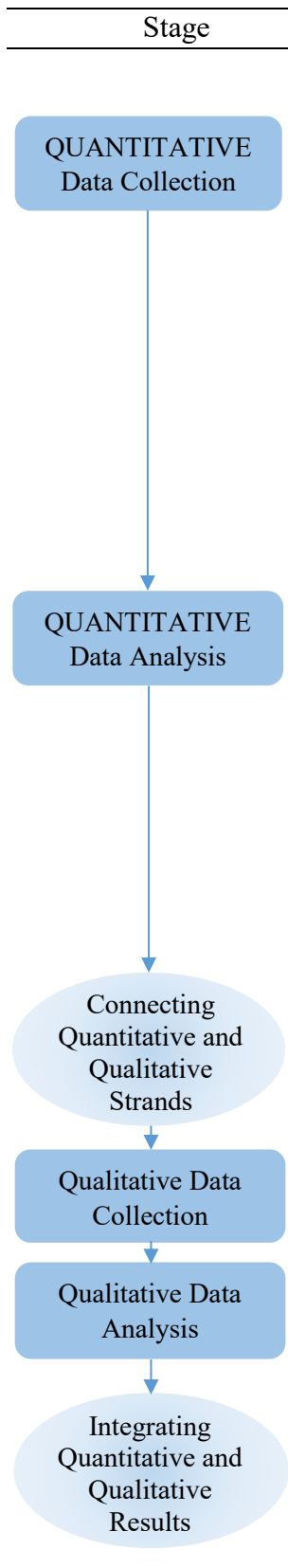
To clarify—for both myself and readers—the sequence and structure of the mixed-methods approach used in this research, I developed a visual model based on the 10 rules outlined by Ivankova et al. (2006) for representing the research design graphically. These guidelines assist in visualizing key elements such as the sequence of data collection and analysis, the priority of the quantitative strand (highlighted in uppercase), the points of integration between the two strands, and the products generated from each. Figure 5.1 (p. 100) illustrates this model.

5.3 Population and Sampling

5.3.1 Population

The current research focuses on middle school students—specifically, 7th- and 8th-

Figure 5.1*Visual Model for Mixed-Methods Sequential Explanatory Design Stages, Procedures, and Products*

Stage	Procedure	Product
 QUANTITATIVE Data Collection	- Self-report questionnaire (T1, $N = 208$) - Math game (T1, $N = 208$) - Math game (T1 + 5w, $n = 201$) - Self-report questionnaire (T2, $n = 194$) - Obtaining school grades (T1 to T5) - Obtaining teachers' evaluations (T2) - Obtaining school certificates (T6)	Open-end textual data, nominal data, ordinal data, interval data, and ratio data
QUANTITATIVE Data Analysis	- Data preparation (EFA, CFA, correlations, reliability; SPSS+AMOS) - Bivariate correlations (SPSS) - Hierarchical multiple regression (SPSS) - Relative weight analysis (RWA Tool) - Dominance analysis (R) - Moderation analyses (Hayes' PROCESS macro in SPSS) - Mediation analysis (Hayes' PROCESS macro in SPSS) - Repeated-measures ANCOVA (SPSS) - MANCOVA (SPSS) - GLM with ordinal logistic link (SPSS) - Crosstabulation - Hybrid Latent Class/Latent Profile Analysis (R, 'Mclust' package) - Mediation analysis using a LMM and an OLS linear regression model (R, 'lme4', 'lm' packages)	- Descriptive statistics, factor loadings, α-values, test-retest r, χ^2 statistics, fit indices - Correlation coefficients r - Regression coefficients, p-value, R^2, F-value - Epsilon weights (ϵ), rescaled weights, bootstrapped CI, dominance weights, R^2 - Interaction term coefficients, main / conditional effects, p-values, R^2, ΔR^2 - Direct / indirect / total effects, p-values, bootstrapped CI - Main + covariate effects (F, p), interaction effects (F, p, η_p^2), post-hoc tests, Wilks' Λ - Regression / threshold coefficients, odds ratios, p-values, CI, fit indices, pseudo-R^2 - Frequencies, percentages, χ^2, p-values, Cramér's V, pairwise comparisons - Cluster memberships, posterior probabilities, cluster number, fit indices, variable means - Direct / indirect / total effects, fixed effects (LMM), random intercept variance (LMM), bootstrapped CI, fit indices (LMM, OLS)
Connecting Quantitative and Qualitative Strands	- Purposefully selecting focus group participants based on post-intervention academic performance + other criteria - Developing focus group questions	- Cases (groups) ($n = 4$) - Participants (students) ($n = 31$) - Focus group interview schedule
Qualitative Data Collection	Conducting four focus groups	Audio recordings, transcripts (supported by f4x software), notes
Qualitative Data Analysis	In-vivo coding, category generation, within- and across-group category analysis (f4 2024 software)	- Visual model of inductive analysis - Four-level coding frame
Integrating Quantitative and Qualitative Results	Interpretation of the quantitative and qualitative results	- Triangulated findings - Contextualized quantitative results - Meta-inferences - Integrated Results Matrices

Note. T1 = Time 1; w = weeks; EFA / CFA = exploratory / confirmatory factor analysis; CI = confidence intervals; η_p^2 = partial eta-squared; χ^2 = chi-square; R^2 = coefficient of determination; LMM = linear mixed model; OLS = ordinary least squares

graders—attending integrated comprehensive schools (Oberschulen) in Bremen. The overall emphasis on middle school, rather than primary school students, stems from the fact that middle school is an optimal period for developing or strengthening resilience / grit (Guerra et al., 2014). While interventions are often more cost-effective earlier in life (Heckman & Kautz, 2013), some self-regulatory and meta-cognitive strategies can be difficult for younger students to grasp (Duckworth et al., 2013). Additionally, traits from the conscientiousness family, to which grit belongs, show stronger associations with academic achievement at the secondary and postsecondary levels than at the elementary level (Poropat, 2009). Similarly, a meta-analysis reveals that both overall grit and its components have a greater impact on success among secondary students compared to primary school students (Lam & Zhou, 2022).

The *specific* emphasis on early adolescence (ages 12 – 14, roughly corresponding to Grades 7 and 8 in Germany) is rooted in the unique developmental challenges and opportunities typical of this often turbulent period, which is marked by rapid physical, psychological, social, and academic changes. Adolescents at this stage experience increases in stress, antisocial behavior, and conflicts with peers and parents, alongside declines in self-esteem, perceived ability, school engagement, and academic performance—factors that commonly result in disengagement from school (Blackwell et al., 2007; Obermeier et al., 2023; Park et al., 2017, 2020; Postigo et al., 2020, 2021). These challenges become pronounced around the age of 12, a time often viewed as a “formal rite of passage” (Blackwell et al., 2007, p. 247), which aligns with the average onset of puberty in Germany (Reschke et al., 2023). The heightened desire to ‘fit in’ with peers further complicates this phase, with academic success often considered ‘uncool’. This dynamic disproportionately affects disadvantaged students, who may view achievement as ‘selling out’ to higher-status or dominant cultural groups (Polirstok, 2017).

These vulnerabilities, however, also make early adolescence a critical window for intervention, as decisions and experiences during this transitional stage can have lifelong consequences (Blackwell et al., 2007; Duckworth et al., 2016; Hwang & Nam, 2021; D. Park et al., 2020; Polirstok, 2017; Santos et al., 2021). According to Bailey et al. (2017), this period is optimal for ‘foot-in-the-door’ interventions, which offer temporary boosts in skills or beliefs to help students navigate high-risk periods and lay the foundation for long-term academic and personal growth. Targeted efforts to foster adaptive traits, such as grit and a growth mindset, hold significant promise for counteracting the aforementioned declines and initiating upward spirals of positive development (Blackwell et al., 2007; Park et al., 2020; Postigo et al., 2020, 2021; Zhang et al., 2024). Notably, traditional educational interventions

addressing issues like bullying, absenteeism, or substance abuse are often less effective for middle adolescents (ages 14–17) than for younger students, but interventions lessening threats to status or respect by promoting an incremental theory of personality—such as the ones proposed in this study—have demonstrated benefits even for older adolescents (Yeager et al., 2018). In sum, focusing on 7th- and 8th-graders aligns with developmental research highlighting early adolescence as a period when interventions can harness students' cognitive, social, and emotional growth to generate positive effects.

The selection of *integrated comprehensive* secondary schools is justified by Germany's evolving educational and demographic context. Most states (Länder) are transitioning from a traditional tripartite secondary school system, consisting of Hauptschule (lower secondary), Realschule (general secondary), and Gymnasium (college-preparatory)⁷³, to a two-pillar system that includes only Gymnasien and integrated comprehensive schools (Gesamtschulen⁷⁴). These schools accommodate a broader range of academic abilities and goals by offering different school-leaving certificates to children of different aptitudes and by enabling students to switch between academic tracks. *Greater sample diversity*, hence, may ensure more variation in grit than seen in much of the existing literature and may lead to a clearer differentiation of intervention results. Moreover, given that students with a migration background are overrepresented in lower-qualifying forms of schooling (Autor:innengruppe Bildungsberichterstattung, 2022b, 2024), focusing on integrated comprehensive schools minimizes the risk of demographic imbalances that could arise if samples were drawn exclusively from either Hauptschulen or Gymnasien.

Bremen, the state chosen for the current study, was selected primarily because its students score the lowest in Germany, on average, in national and international tests of academic competency in subjects such as mathematics, natural sciences, and (German) reading comprehension: e.g., IQB assessment studies⁷⁵, IGLU⁷⁶, and PISA (Autor:innengruppe Bildungsberichterstattung, 2024). Bremen also ranks last among the German Länder in the INSM Bildungsmonitor, an annual comparative study evaluating states on 13 key education indicators: spending prioritization, input efficiency, mentoring conditions, support infrastructure, internationalization, time efficiency, school quality (where

⁷³ The system also includes special needs schools, trade and technical schools, various types of vocational schools, Waldorf schools, specialized academies, private schools, international schools, and a few others.

⁷⁴ In Bremen, which is the chosen location for this study, the comprehensive school is named Oberschule.

⁷⁵ IQB - Das Institut zur Qualitätsentwicklung im Bildungswesen (The Institute for Educational Quality Improvement)

⁷⁶ IGLU - Internationale Grundschul-Lese-Untersuchung, known internationally as PIRLS - Progress in International Reading Literacy Study

Bremen ranks last!), educational deprivation, integration, vocational education / employment market orientation, college / MINT⁷⁷ focus, research orientation, and digitalization (Anger et al., 2024). Consequently, as the ultimate aim of the current research is to provide educators with a tool to help students perform better in school and achieve their goals, it follows that the highest potential—and greatest need—for improvement is where school quality and academic performance lag.

Thus, the statistical population for this study—both the pilot study (Chapter 4) and the implementation and evaluation phases—is defined as 7th- and 8th-graders attending integrated comprehensive secondary schools (Oberschulen) in Bremen, for whom grades are available for at least one semester and who have access to computer/media labs at school.

5.3.2 Sample Sizes

A power analysis was conducted using G*Power (Faul et al., 2007) to determine the minimum sample size required for a research design with four conditions (a between-subjects factor) and repeated measurements (pre- and post-intervention) as the within-subjects factor. While power calculations may be viewed as less applicable in quasi-experimental studies—due to the absence of individual-level randomization, potential clustering effects, and practical constraints that may violate the traditional assumptions of power analyses—they can still serve as valuable planning tools. In this study, the power analysis was used to set rough recruitment targets, estimate permissible attrition, and assess the overall feasibility of the study design.

The analysis was based on an effect size estimate of partial $\eta^2 = .02$, corresponding to a small effect (J. Cohen, 1992). This estimate was informed by meta-analytic findings, such as those reported by Durlak et al. (2011), who calculated a mean effect size of .27 (Hedges' g ⁷⁸) for the impact of social-emotional learning (SEL) interventions on academic performance in school settings. Other reviews of related interventions have identified effect sizes ranging from .11 to .30 (Hedges' g), further supporting the expectation of small effects in this context. A statistical power of .80 (i.e., an 80% chance of detecting a true effect, assuming it exists) is commonly recommended in behavioral and social science research (J. Cohen, 1992) and would result in a minimum sample size of 140 participants (35 per group). However, increasing the power to .90 is often advised for detecting smaller effects, resulting in a

⁷⁷ MINT subjects: Math, Informatics, Natural Sciences, Technology; Interestingly, Bremen places 1st in Germany on this indicator, with the highest proportion of MINT scientists among the academic staff working in universities.

⁷⁸ Hedges' g is a variation of Cohen's d that adjusts for potential bias in estimating effect sizes when sample sizes are small (Durlak et al., 2011).

required sample size of 180 participants, or 45 participants per group. Thus, to ensure adequate power for detecting meaningful effects and account for potential participant attrition, the target sample size for this study was set at a minimum of 200 participants, with a goal of 50 participants per group.

For the qualitative strand, sample size was determined by data sufficiency considerations, with two focus groups per academic trajectory (improved and stagnated/worsened) to avoid group-specific biases, and group sizes of seven to nine participants to foster meaningful interaction. Further details on focus group sample size are provided in section 9.2.

5.3.3 Sampling Strategies

The sampling strategy for the implementation and evaluation phases involved *purposeful sampling* of Oberschulen in Bremen, selecting schools based on size and student demographics that could provide rich, relevant information to the research purpose (Patton, 2014). Given that a maximum of 25 students can be taught in one class in this school type, the chosen school needed at least four parallel Grade 7 and four parallel Grade 8 classes, totaling up to 200 students. However, prior research conducted in the U.S. indicates that participation rates in school-based studies requiring active parental consent (opt-in) can vary widely, ranging from 11% to 100%, with an average rate of approximately 65.5%. Moreover, obtaining signed consent is particularly challenging in urban schools, which are often under-resourced and where parental engagement in school-related activities tends to be lower (Blom-Hoffman et al., 2009). Given that Oberschulen in Bremen share similar characteristics, and opt-in parental consent is mandated by the regional Ministry of Education for school-based research, a comparable average participation rate was anticipated. This implied that the chosen school needed a combined enrollment of approximately 300 students across Grades 7 and 8 to ensure an adequate sample size.

The only school meeting the size criterion was Gesamtschule Bremen-Ost (GSO), located in the Osterholz-Tenever district of Bremen. This district, home to approximately 10,000 residents from over 90 nationalities, is characterized by significant socioeconomic challenges: 67% of residents have a migration background (among minors, this number increases to 80%), and more than a third of all residents rely on social benefits⁷⁹.

Additionally, almost three-quarters of the district's youth leave school without the Abitur

⁷⁹ In this text by the Urban Development Support programme of the Federal Ministry for Housing, Urban Development and Building, the terms “Migrationshintergrund” (migration background) and “Migrationsanteil” (proportion of migrants) are used without strict definitions.

(Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen, 2021). With around 1,360 students, GSO is Bremen's largest integrated comprehensive secondary school and has the capacity to accommodate six parallel classes in both Grades 7 and 8 (Bremische Bürgerschaft, 2017). Furthermore, GSO is representative of the demographic, socioeconomic, and academic profile of Oberschulen in Bremen, ensuring that the findings are likely to be applicable to similar schools in the region.

For the qualitative strand, I used *mixed purposeful sampling*, combining stratified purposeful, intensity, and maximum variation sampling to select participants based on key criteria (Patton, 2014). Students were first grouped by cohort (Grade 8 or Grade 9) and academic outcomes following the intervention (improved vs. stagnated/worsened), resulting in four distinct subgroups. Intensity sampling was applied to capture a range of academic trajectories within each academic outcome category, while maximum variation sampling ensured diversity within each group by considering class membership, experimental condition, and gender. A more detailed description of the sampling strategy for the qualitative strand can be found in section 9.1.

5.4 Measurement Instruments

5.4.1 Self-report Measures

Domain-general grit was assessed both pre- and post-intervention using the German version of the ubiquitous 8-item Grit-S scale (BISS-8; Schmidt et al., 2019). Although the longer, domain-general Grit-O scale has also been translated and validated in German (Fleckenstein et al., 2014), only the BISS-8 has a school-specific version, making it uniquely suitable for this study. This instrument consists of four items for each subscale: grit-CI and grit-PE. Based on feedback from the pilot study (section 4.4.2), three items from the German translation of the Grit-S were slightly modified. An example item from the consistency of interest subscale is: 'I have difficulty maintaining my focus on projects that take more than a few months to complete'⁸⁰, and an example from the perseverance of effort subscale is: 'Setbacks don't discourage me'⁸¹. Responses were recorded on a 5-point Likert scale, ranging from (1) 'not true at all' to (5) 'completely true', with higher scores on the consistency of interest subscale recoded to reflect higher grit.

School-specific grit was assessed using the modified version of the BISS-8, in which items were tailored by Schmidt et al. (2019) to focus specifically on students' perseverance

⁸⁰ The final German version of this item, revised based on feedback from the pilot test, reads: 'Ich habe Schwierigkeiten bei Projekten voll dabei zu bleiben, wenn diese mehrere Monate dauern'.

⁸¹ The final German version of this item, revised based on feedback from the pilot test, reads: 'Von Rückschlägen (Niederlagen) lasse ich mir nicht den Mut nehmen'.

and consistency *within the school context*, enabling the comparison of a domain-specific measure with the domain-general measure. An item from this scale reads, ‘I often set a goal in school but later choose to pursue a different one’⁸².

The set of self-reported measures included additional non-cognitive attributes closely associated with grit, namely conscientiousness, self-efficacy, self-control, (growth) mindset, and sense of belonging. Conscientiousness was assessed using two items from the German BFI-10 (Rammstedt et al., 2013), one of which was rephrased based on pilot study feedback. School self-control was measured with a 4-item academic self-control scale (Park et al., 2017), translated into German for this study (e.g., ‘I come to class prepared’⁸³). The focus on academic self-control rather than interpersonal self-control reflected its stronger relevance to school behaviors and performance, as well as its high correlation with grit, both being measures of intrapersonal character. School self-efficacy was evaluated using the 5-item version of a scale by Jerusalem and Satow (1999, e.g., ‘I can solve even difficult tasks in class if I try hard’)⁸⁴, with minor modifications to three items post-pilot testing. This domain-specific measure was chosen for its greater relevance in the school context and its established links to academic performance and grit (e.g., Steinmayr et al., 2018). School belonging was measured with three items translated for this study from Layous et al. (2017), such as ‘People in my school accept me’⁸⁵. Research suggests that grit predicts a sense of belonging (e.g., Bowman et al., 2015), which, in turn, has a positive direct effect on perseverance of effort (e.g., Verdín et al., 2018) and supports well-being and academic performance (e.g., Walton & Cohen, 2007, 2011; Yeager, Walton, et al., 2016). Finally, implicit theories of intelligence (fixed vs. growth mindset) were assessed using a German version (Spinath, 2001) of Dweck et al.’s (1995) 3-item measure (e.g., ‘My intelligence is something I can hardly change’⁸⁶), with one item revised following pilot feedback. Responses on all of these self-report measures were recorded on the same 5-point Likert scale used for the grit measures, ranging from (1) ‘not true at all’ to (5) ‘completely true’.

Behavioral school engagement was assessed using three items adapted from the Profiles of Student Life: Attitudes and Behaviors scale (PSL-AB; Leffert et al., 1998) and three items from the 4-H Study of Positive Youth Development (Lerner & Lerner, 2013). These items measured habits related to homework completion, attendance, class preparedness,

⁸² German version: ‘In der Schule nehme ich mir oft etwas vor, verliere mein Ziel dann aber aus den Augen’.

⁸³ German version: ‘Ich komme vorbereitet in den Unterricht’.

⁸⁴ German version: ‘Ich kann auch die schwierigen Aufgaben im Unterricht lösen, wenn ich mich anstreng’.

⁸⁵ German version: ‘Die Leute in meiner Schule akzeptieren mich’.

⁸⁶ German version: ‘Meine Intelligenz ist etwas, das ich kaum verändern kann’.

and participation (e.g., ‘During the last month, I never / rarely / sometimes / often / always did my homework’⁸⁷). Research shows that engagement in learning activities is a strong predictor of achievement (e.g., Muenks et al., 2017; Steinmayr et al., 2018). Moreover, school engagement is highly correlated with grit (Muenks et al., 2017; Suzuki et al., 2015; Von Culin et al., 2014) and has been explored as a mediator in the grit-achievement relationship (e.g., Hodge et al., 2018; O’Neal et al., 2018), which plays a central role in the current research.

Additionally, at Time 1 (pre-intervention), students were asked to identify two personal goals—one academic and one non-academic—that they aimed to achieve within the following three to six months. At Time 2 (post-intervention), they evaluated the importance of these goals and their progress toward achieving them using four self-constructed items: ‘This goal is still important to me’, ‘How much have you done so far to achieve this goal?’, ‘To what extent have you already achieved this goal?’, and ‘If you are currently still working toward this goal, do you think you can still achieve it?’⁸⁸. A single item assessing interest in math (‘In your opinion, how interesting is the subject of math?’) and another for math anxiety (‘In general, how much does the subject of math in school make you feel nervous, worried, or full of anxiety?’⁸⁹) were translated from Yeager, Romero, et al. (2016) and included to avoid confounding findings on performance or perseverance in the math game with pre-existing math-related interest or anxiety.

Students were also asked about their school qualification and training/vocational qualification goals using two items from the PISA survey (Kunter et al., 2002). Additionally, they were asked to provide their gender and age. Finally, three items assessing German language proficiency, adapted from the German Socio-Economic Panel survey instruments for youth (SOEP Group, 2021), and two items about the number of books at home, adapted from Boehnke (1982), were included to assess students’ socio-educational advantage (SEA). The construction of the SEA Index is detailed in section 6.4. The complete scales included in the students’ questionnaire are provided (in German) in Appendix E.1 (p. 340).

5.4.2 Mathematical Real Effort Task

A behavioral measure of grit, adapted from Alan et al. (2019), was administered pre- and post-intervention in the form of a computer-based mathematical real-effort task designed

⁸⁷ German version: ‘Im letzten Monat, habe ich meine Hausaufgaben nie / selten / manchmal / oft / immer gemacht’.

⁸⁸ German versions: ‘Dieses Ziel ist mir immer noch wichtig’, ‘Wie viel hast du bisher getan, um dieses Ziel zu erreichen?’, ‘Inwieweit hast du dieses Ziel bereits erreicht?’, ‘Falls du derzeit immer noch Mühe und Zeit in dieses Ziel steckst, glaubst du, dass du es noch erreichen kannst?’

⁸⁹ German versions: ‘Wie interessant ist deiner Meinung nach das Fach Mathematik?’, ‘Wie sehr macht dich das Fach Mathematik in der Schule nervös, besorgt oder voller Angst?’

to assess respondents' willingness to attempt a difficult addition game after experiencing failure. During the pilot test, the original version of the math game, which gave students 90 seconds to identify at least three pairs of numbers adding up to 100 within a grid, proved too easy for 7th- and 8th-graders, leading to overly high success rates. To address this, the game's difficulty was increased by expanding the number grid for the difficult level from 4x5 (20 numbers) to 5x5 (25 numbers) and using pairs of numbers adding up to 1000 instead of 100. This change ensured the task was challenging enough for identifying grit-related behaviors. Example grids for the easy and difficult games are provided in Appendix E.2 (p. 346).

5.4.3 Intervention Instruments

For the Academic Mindsets condition, the intervention drew on extant psychologically 'wise' interventions, delivering elements from growth mindset, social belonging, value affirmation, and sense-of-purpose interventions totaling 38 minutes of content.

For the growth mindset module, original materials developed by Paunesku et al. (2015) and further refined by Yeager, Romero, et al. (2016) were transadapted through a user-centered design process (detailed in Ch. 3) to teach participants that the brain and intelligence can grow with effort and practice. One exercise, which asked students to reflect in writing on their successes and failures, was adapted from Jones et al. (2018). Additionally, content and illustrations from the *Khan Academy* Growth Mindset course, created in partnership with PERTS—a Stanford University-based edtech nonprofit founded by Dave Paunesku that translates research into practical, scalable solutions—were incorporated⁹⁰. Lastly, I received complimentary access to the complete Brainology® middle school curriculum, developed by *Mindset Works*, a global leader in growth mindset education based on the work of Carol Dweck and Lisa Blackwell, from which I adapted various elements, tasks, and quizzes⁹¹.

The school belonging module was tailored for the intervention target group using the customization and implementation guide for social belonging interventions developed by Walton et al. (2017). These interventions aim to help students understand that concerns about belonging during and after academic transitions are normal, temporary, and shared by others. To convey this message, the interventions feature stories from diverse older students that illustrate how initial worries about fitting in at a new school are common but fade over time as students build connections. A few of these stories were also adapted from Goyer et al. (2019).

The short values affirmation module is based on a study by Layous et al. (2017). Self-affirmation interventions help students reaffirm their personal integrity and sense of

⁹⁰ Available at <https://www.khanacademy.org/college-careers-more/learnstorm-growth-mindset-activities-us>

⁹¹ Available at <https://www.mindsetworks.com/ProductPages/Teachers>

competency by having them select from a list (e.g., religion, family) one or two values that are most meaningful to them and write about why these values are important. This approach has been shown to improve academic performance, particularly for students who face negative stereotypes related to race, gender, or social status.

The sense-of-purpose module, which rounds out the Academic Mindsets intervention, is based on materials from Yeager et al. (2014). Their research found that when school tasks are hard to engage with, promoting a prosocial, self-transcendent purpose for learning can help students create personal meaning. This approach boosts both trait-level academic self-regulation (e.g., self-reported grit and academic self-control) and behavioral persistence (e.g., short-term persistence on a boring math task and long-term persistence in college).

The grit intervention for the Learning Skills and Strategies condition included elements from existing interventions on self-control, deliberate (deep) practice, and goal-setting (MCII), delivering 48 minutes of content.

The self-control module was based on the process model of self-control outlined by Duckworth et al. (2014) and tested in field experiments (Duckworth et al., 2016). This model organizes strategies for resisting immediate temptations into sequential phases: situation selection, situation modification, attentional deployment, cognitive change, and response modulation. It emphasizes that strategies employed earlier in the impulse regulation process are generally more effective than those used later.

The materials for the deliberate (deep) practice module were generously provided by one of the authors of the largest grit intervention to date—a nationwide, low-cost program designed to enhance grit and self-regulation among approximately 33,000 sixth- and seventh-grade students in 350 primary schools across North Macedonia (Santos et al., 2021). This intervention is built around a curriculum that teaches and motivates students to adopt the principles of deliberate practice, including identifying stretch goals, seeking feedback, maintaining focus, and repeating tasks until mastery (Ericsson et al., 1993). Research has shown that deliberate practice fosters grit (Duckworth, Kirby, et al., 2011), mediates the relationship between grit and achievement (e.g., S. Lee & Sohn, 2013), and improves academic performance (e.g., Eskreis-Winkler, Shulman, et al., 2016).

Lastly, the goal-setting (MCII) module drew on the work of Duckworth et al. (2011; 2013)⁹², who applied this self-regulatory strategy with high-school students and disadvantaged middle-school students, resulting in significant improvements in goal

⁹² The 2011 reference is Duckworth, Grant, et al. (2011).

achievement, academic performance, attendance, and conduct. MCII, also known as WOOP (Wish, Outcome, Obstacle, Plan), involves envisioning a desired future, identifying potential obstacles, and creating specific ‘if-then’ plans to overcome them. To develop the module’s content, I utilized the WOOP manual provided on a dedicated website by Prof. Dr. Gabriele Oettingen, the creator of the method⁹³.

Each grit intervention (AM and LSS) was delivered as an online course featuring reading sections, video materials, interactive components, various exercises and quizzes, and an additional offline pen-and-paper writing task using the ‘saying-is-believing’ technique. This method, commonly employed in educational and psychological interventions, involves students writing a brief letter encouraging others to e.g., persist through challenges, which in turn strengthens their own perseverance and belief in the value of effort. By leveraging cognitive consistency, the approach helps students internalize ideas they publicly endorse.

5.4.4 Outcome Measures

Along with self-reported achievement of academic and personal goals, several other dimensions of school-related success were assessed. Academic performance was measured both pre-intervention and at four time points post-intervention using end-of-term grades in German, English, Social Sciences, Mathematics, and Natural Sciences. These grades were used to compute a GPA for each school term (see section 6.6 for details). Additionally, academic progress was evaluated three months post-intervention by class teachers, who rated students’ performance in the second half of the year compared to the first half using a five-point scale (much worse, somewhat worse, about the same, somewhat better, much better). Finally, students’ educational attainment was assessed five years post-intervention based on either the type of (lower) school-leaving certificate obtained or the students’ continued enrollment in the Abitur track.

5.4.5 Focus Group Interview Schedule

The focus group interview schedule for the qualitative strand of the research followed a funnel strategy, starting with general, rapport-building questions about participants’ learning habits and recent school experiences. The main section focused on students’ memories and experiences with the grit interventions, probing which aspects of the online courses had left a lasting impression. The schedule included ladder questioning to explore participants’ reactions to the content, application of grit-building strategies, and any perceived personal changes post-intervention. This data collection instrument is described in detail in section 9.3

⁹³ For details see <https://woopmylife.org/de/practice>

and is also provided in its entirety (in German) in Appendix D.2 (p. 338).

5.5 Participants

The sample for the quantitative strand consisted of 208 Grade 7 and 8 students, aged on average 13.5 years ($SD = 0.708$), with no significant differences in age, gender, socio-educational advantage (SEA), or grit between conditions. The study employed an opt-in design, with signed consent obtained from parents / legal guardians⁹⁴ and informed assent collected digitally from students at the start of the online intervention. To encourage the return of parental consent forms, regardless of participation, three 10-euro shopping vouchers were raffled among students who submitted a signed form. Roughly 75% of eligible students in Grades 7 and 8 participated, though attendance on study dates varied due to illness.

Twelve school classes were randomly assigned to one of four conditions, resulting in an inevitable imbalance in the distribution of Grade 7 and Grade 8 students across conditions. Each condition included either two Grade 7 classes and one Grade 8 class, or two Grade 8 classes and one Grade 7 class, leading to a significant Chi-Square test for cohort distribution ($p < .05$), which reflects this systematic allocation rather than meaningful bias. Additionally, group sizes were uneven due to variations in parental consent and actual attendance on the intervention days: AM (39 students, 18.8%), LSS (61 students, 29.3%), COMB (54 students, 26%), and control group (54 students, 26%).

Of the 208 participants, 14 were absent for the self-report measures at Time 2 (eight months post-intervention) due to school transfers or illness. School grades were available for 188 students at Time 1 (pre-intervention), 195 at Time 2, 191 at Time 3, and 188 at both Time 4 and Time 5. Teacher evaluations collected at Time 2 were available for 205 students. Long-term educational attainment data (Time 6, five years post-intervention) were successfully obtained for 194 students. Sociodemographic characteristics of the participants, including grade level, gender, and SEA, are summarized in Table 6.1, p. 121 (Chapter 6).

The qualitative strand sample included 31 students from the three experimental conditions, at that time already in Grades 8 and 9, distributed across four focus groups. No demographic data was collected from these participants. Participant selection criteria are briefly outlined in section 5.3.3 (this chapter) and discussed in detail in section 9.1.

5.6 Procedures

After securing approval from the regional Ministry of Education in spring 2019, and with the agreement of the GSO school administration, the study was conducted over several

⁹⁴ The consent form for parents / legal guardians (GSO) is provided in Appendix B.10, p. 327.

sessions from May 2019 to July 2020, including both quantitative and qualitative elements⁹⁵.

5.6.1 Implementation Phase (Quantitative Strand)

The intervention was delivered during regular school hours on four consecutive days in late May 2019, with one condition (i.e., three classes) assigned per day. Sessions were held on school premises in three computer rooms, supervised by the teachers who would have taught the assigned classes during that period. Teachers followed a standardized script to explain participation rules (e.g., no talking, no visiting unauthorized websites) and guide students through each section of the intervention⁹⁶. Students not taking part in the study were permitted to work quietly on other tasks, such as completing homework.

All students began the session by reviewing information on data privacy and study procedures and providing digital assent⁹⁷, followed by the completion of a web-based self-report questionnaire (45 minutes). They then played the math game, which lasted 15–20 minutes, including the time needed for instructions and a practice round. Students in the control group were debriefed, thanked for their participation, and dismissed after completing the game. All other students participated in the grit intervention corresponding to their assigned condition, and those in the combined condition attended the second online course one week later. Headphones were required for the game and the online course, with in-ear headphones provided to students who forgot their own. A few tasks required offline work, for which materials were supplied during the session. At the end of the intervention sessions, students received take-home postcards featuring the ‘badges’ they earned for completing each module in the course(s) they participated in.

5.6.2 Follow-Up Assessments

Five weeks after the intervention, all students, including those in the control group, completed a second round of the math game (10–15 minutes). This follow-up session was conducted under the same conditions as the initial session, with three classes assigned per day across four consecutive days. At the end of January 2020, students completed the full set of self-report measures again in a 45-minute session, with two conditions (six classes) assessed per day over two days. Students who were absent during the follow-up sessions due to illness were offered a make-up opportunity, though not all participated.

5.6.3 Incentives

The math games were incentivized with entries into a raffle for two 25-euro shopping

⁹⁵ The GSO school consent form is provided in Appendix B.8, p. 324.

⁹⁶ One example of the teacher script (for classes in the AM condition) is included in Appendix C.2, p. 333.

⁹⁷ The text of the digital assent form (GSO) is provided in Appendix B.9, p. 326.

vouchers. In the first session, one game round was chosen randomly, and students earned three raffle entries for having won the easy math game, five entries for having won the difficult game, and one entry for an unsuccessful attempt at either level. In the second session, students earned three or five additional entries based on the difficulty level they chose and on whether they were successful in the game.

5.6.4 Evaluation Phase (*Qualitative Strand*)

Thirteen months after the intervention, in early July 2020, four focus groups were conducted on the school premises. Each session, lasting 77–88 minutes, adhered to a structured format with clear ground rules and moderator-led questions designed to foster individual input. Participants were compensated with €10 shopping vouchers. The full procedure for the qualitative strand is detailed in section 9.4.

5.7 Data Analysis: Brief Overview

5.7.1 Quantitative Strand

The data analyses for the quantitative strand of the study were performed using SPSS / AMOS, R, and the RWA Web Tool, with techniques carefully selected to match the nature of the research questions and data structure. Data preparation and validation processes (Chapter 6) ensured that the measures used were appropriate and reliable for subsequent analyses. Missing data were handled via listwise deletion, with additional justifications provided for specific exclusions. Assumptions of normality, homogeneity of variance, and sphericity were tested, and violations were addressed using robust methods such as bootstrapping, which allowed for the estimation of confidence intervals and significance levels without relying on normality assumptions. Dimensionality and construct validity of scales, including domain-general and school-specific grit, were assessed using Exploratory Factor Analysis (EFA) in SPSS and Confirmatory Factor Analysis (CFA) in AMOS. Descriptive statistics and correlation coefficients were computed after mean centering and dimension reduction of variables through exploratory factor analysis (EFA). Below, the specific analytical methods applied for each RQ are outlined.

RQ 1 focused on examining the relationships between domain-general grit, school-specific grit, and their related constructs. This analysis was conducted in two steps. First, bivariate correlations were calculated to explore the associations between these constructs, providing a descriptive overview of their interrelations. Second, hierarchical multiple regressions were employed to identify the strongest predictors of grit and evaluate the asymmetry in their bidirectional relationships. Given that several variables deviated from normality, bootstrapping techniques were applied to enhance the robustness of the analyses.

The analyses for RQ 2a through 2d focused on understanding the relationship between grit and GPA, the relative importance of grit among other predictors, and the influence of potential moderators. For RQ 2a, hierarchical regression analysis was used to evaluate the unique contribution of grit to GPA after controlling for socio-educational advantage (SEA) and other covariates. RQ 2b employed Relative Weight Analysis (RWA), conducted using the RWA Web tool, to quantify the relative contribution of each predictor to the explained variance in GPA, and Dominance Analysis (DA), performed in R, to evaluate predictors' consistency across all subset models, providing a triangulated perspective on predictor importance. For RQ 2c, the moderation effects of SEA, gender, cohort, and academic ability on the relationship between school grit and GPA were tested. Hayes' PROCESS macro in SPSS was used for socio-educational advantage, gender, and cohort. For academic ability, which is a categorical version of the dependent variable (GPA), a traditional regression with interaction terms was used to examine how the relationship between school grit and GPA varied across academic ability levels. Finally, RQ 2d employed mediation analysis via PROCESS to test whether school engagement mediated the relationship between school grit and GPA, with bootstrapping ensuring robust confidence intervals for indirect effects.

RQ 3, comprising sub-questions 3a to 3g, assessed the effects of the interventions on academic and personal outcomes. Longitudinal self-report measures and GPA data were analyzed using repeated-measures ANCOVA in SPSS to evaluate changes over time while controlling for baseline differences. For multivariate outcomes, such as personal goal achievement, MANCOVA was used, incorporating covariates like gender, SEA, and school belonging. Teacher evaluations and long-term educational attainment were analyzed using ordinal logistic regression to model ordinal outcomes.

For RQ 4, a comparative synthesis was conducted to evaluate the effectiveness of the three grit interventions (AM, LSS, and AM + LSS) across various outcomes. This approach integrates and compares findings from independent analyses conducted for each outcome. Rather than applying a single statistical model to analyze all outcomes together—an approach limited by factors such as sample size, the diversity of dependent variables, and the complexity of interactions—the comparative synthesis provides insights into the relative impact of each intervention while accommodating the distinct nature of the dependent variables and the constraints of the study design.

RQ 5 sought to identify the groups that benefited most from the grit interventions. A hybrid Latent Class/Latent Profile Analysis (LCA/LPA) was conducted using the 'Mclust' package in R to identify distinct student profiles based on a combination of categorical and

continuous variables, including SEA and school grit. The two clusters identified were subsequently used as grouping variables in a repeated-measures ANCOVA to evaluate how intervention type (Treatment) and student cluster membership interacted to influence changes in GPA over time, with covariates included to control for baseline differences.

Finally, RQ 6 investigated the mechanisms underlying the intervention effects on academic performance. A mediation analysis was carried out to test whether school engagement mediated the relationship between the interventions and GPA. Linear mixed models (LMM) in R, implemented via the ‘lme4’ package, were used to capture the repeated-measures nature of GPA data, accounting for within-subject variability with random intercepts. For the mediator model (school engagement), measured at a single time point, an ordinary least squares (OLS) linear regression model was applied using the ‘lm’ function in the base R package. Bootstrapping was used to estimate confidence intervals for the total, direct, and indirect effects, ensuring robust estimates of mediation pathways.

5.7.2 Qualitative Strand

The qualitative data from focus groups were analyzed using Thomas’ (2006) general inductive approach, which involves systematically reducing raw data through inductive coding to identify key concepts and themes aligned with the research objectives. The analysis unfolded in four steps: transcript preparation, familiarization with the data to identify preliminary categories, in vivo coding to label meaningful text segments, and iterative refinement of the coding frame into a set of broad categories and subcategories. This process yielded seven major categories, including participants’ perspectives on school, learning habits, factors influencing school progress, and reflections on the grit interventions, providing a structured yet flexible framework for uncovering both expected and emergent insights.

5.8 Methodological Considerations

5.8.1 Limitations

One primary *design*-related limitation of the proposed research is the potential for spill-over effects from the grit interventions to other psychological characteristics (Hillygus et al., 2016). While the interventions aim to influence specific psychological resources contributing to grit, they may inadvertently affect unrelated attributes not explicitly accounted for in the study, which could, in turn, drive some of the observed effects. This challenge is further compounded by the inherently ‘fuzzy’ nature of grit as a concept. Although this study attempts to operationalize grit meaningfully by testing its application in a real-world setting, the results, while certainly valuable in practice, remain imprecise in a strict scientific sense.

Another common limitation in grit research, and in this study specifically, is the

(exclusive) reliance on self-report measures, which can be subject to range restriction due to factors such as weak introspective ability, social desirability bias (e.g., DiMenichi & Richmond, 2015), or reference bias (e.g., Lira et al., 2022). While self-reports provide important insights, incorporating multisource measurements of grit (e.g., teacher or parent evaluations) would improve validity (Duckworth & Quinn, 2009; Boon-Falleur et al., 2022). Due to time constraints and limited access to teachers, alternative measures like an informant-report version of the Grit-S scale or a biodata measure of self-reported participation in extracurricular activities were dismissed early in the research process. Nonetheless, this study sought to partially address the measurement limitation by piloting a behavioral measure of grit—a computer-based math game adapted from Alan et al. (2019). Unfortunately, challenges in its implementation and insufficient time for a comprehensive analysis of the results led to its exclusion from the final analyses.

An additional measurement shortcoming is the *exclusive* reliance on school grades as a measure of academic performance. While grades ostensibly assess students' achievement of curricular goals, they are also “guided by the teacher's impression of the student's ‘fit’ into the system school or class” (Boehnke, 1996, p. 42). As such, they serve as both ideal and flawed outcome measures in a study on grit: ideal because they also capture aspects of a student's personality and effort (e.g., time on task), acting as proxies for grit; flawed because, on their own, they do not measure students' gains in content knowledge or objective skills *reliably*. The inclusion of standardized test scores—e.g., from IQB, PISA, or IGLU, sadly not available for this study—would complement grades and provide a more comprehensive measure of academic progress. This limitation will be explored further in section 10.3.1.

A fourth limitation concerns the generalizability of the results. Participants were drawn from a single secondary school in Bremen, and while the sample is fairly representative of the local target population of 7th- and 8th-graders in integrated comprehensive schools, differences between this and other populations or contexts may limit the external validity of the results. Moreover, as participation was voluntary (opt-in), students who participated might systematically differ from those who opted out (e.g., in motivation, parental involvement, or baseline grit levels), limiting the representativeness of the sample. However, the relatively high participation rate (75%) helps mitigate these concerns by reducing selection bias. In sum, the findings are likely transferable to educational settings with comparable conditions.

Efforts were made to mitigate risks to reliability and internal validity. Established instruments with demonstrated reliability and validity were used, reducing measurement error and strengthening internal validity. Practice (test-retest) effects were minimized by spacing

data collection points eight months apart, carefully balanced to avoid the risk of history or maturation effects. A cluster-randomized quasi-experimental design was employed, and baseline differences were controlled to improve causal inference. However, an experimental design with individual-level randomization would have been preferable but was logistically infeasible in this school setting. While the sample size provided just enough statistical power to detect small effects, larger group sizes would have strengthened the analyses further.

One significant challenge, linked to the uneven group sizes, was the lack of control over external factors influencing student participation and engagement. Among the 12 classes involved, notable differences in teacher support and buy-in were observed. Some class teachers actively encouraged near-total participation among their students, while others downplayed the study's importance, potentially undermining student motivation. Moreover, supervising teachers—who were not always the class teachers—varied in their enforcement of rules during the interventions, particularly when I was monitoring implementation in other rooms. While some ensured smooth implementation by closely monitoring adherence to the rules, others were less invested, leading to discipline issues. These inconsistencies likely introduced variability in participants' engagement with the interventions.

Attrition also posed a challenge, with 14 students lost between Time 1 and Time 2 and further dropouts during subsequent data collection points. Finally, not all data met the assumptions required for some statistical analyses. These issues were addressed as thoroughly as possible, as detailed in section 6.3 and in Chapters 7 and 8, but they may still have influenced the robustness of specific findings.

5.8.2 Strengths

These shortcomings are balanced by several methodological strengths that enhance the study's rigor, relevance, and contribution to the field. A key strength is the comprehensive mixed-methods design, employing a sequential explanatory approach that combines quantitative and qualitative data to provide a richer understanding of the intervention's effects. Focus group data provide insights into unmeasured confounding factors, such as teacher quality, class dynamics, and home environments, mitigating the risk of over-reliance on quantitative data and helping to contextualize findings within the broader school setting.

The longitudinal segment of the quantitative strand (Chapter 8), with multiple follow-up points over an extended period—including data on educational attainment collected five years post-intervention—is exceptionally rare in grit research, where cross-sectional designs dominate. Additionally, the study utilizes a sophisticated design that includes a control group, random assignment of entire school classes to conditions, and mixed-design features, allowing

for causal inferences while maintaining ecological validity in a real-world school setting. The inclusion of subgroup analyses, utilizing student clusters based on grit, school engagement, and SEA levels, adds depth by exploring differential effects among diverse student profiles.

Another significant strength lies in the rigorous development and validation of measurement and intervention instruments. These tools were adapted or co-developed with representative students and teachers through a meticulous process involving feasibility and usability testing, as detailed in Chapter 4. This collaborative and iterative approach ensured that the instruments were both practical and relevant to the target population.

The integration of multiple academic outcomes with additional measures, such as progress on self-selected *personal* goals and qualitative feedback on intervention effects, addresses common limitations in grit research, which often focuses narrowly on self-reported grit and / or single indicators of (academic) achievement. Furthermore, the inclusion of both domain-general and school-specific measures of grit—a rare approach in grit research—enables a direct comparison of their respective association with GPA, offering a more nuanced understanding of grit’s role in academic outcomes.

Finally, the focus on comprehensive school students in Bremen—a population often underserved and facing educational disadvantages—enhances the practical significance of the research. Conducting the study in the largest secondary school in Bremen, with participation from 12 classes, underscores its feasibility and scalability, even in a challenging educational context. These methodological strengths position the study as a valuable contribution to the field, offering robust, contextually grounded insights into the impact of grit interventions.

5.9 Ethical Considerations

This study followed the recommendations of the German Research Foundation (DFG) and the German Psychological Society (DGPs) on quality assurance in research. Data collection and storage complied with legal requirements and institutional guidelines, ensuring strict confidentiality and the protection of students’ privacy and anonymity. Approval was obtained from the regional Ministry of Education, which reviewed every questionnaire item, consent and assent form, content element, and informational material for teachers and administrators, adhering to ethical guidelines for research involving minors in school settings.

To preserve student anonymity, participants were represented only by self-generated alphanumeric codes, with names and codes stored separately. The school retained access to both datasets to facilitate follow-up activities. All collected data were stored securely on the password-protected server of the Bremen International Graduate School of Social Sciences (BIGSSS) and were fully anonymized for analysis and publication.

The ethical framework also emphasized voluntary participation and informed consent. Students and their legal guardians received detailed information about the study's purpose, procedures, and data handling practices before providing consent / assent. The study posed minimal risk to participants, as all intervention materials were educational in nature. Students were informed that they could opt out of any activity or withdraw from the study without academic or disciplinary consequences. Teachers were present during activities to supervise and address any concerns. By implementing these measures, the study ensured the protection of participants' rights and privacy, providing an ethical foundation for all research activities.

6 Data Preparation and Validation

In this chapter, I detail the procedures employed to prepare the data for subsequent analyses, an essential step to ensure the accuracy and validity of the findings. The dataset comprises a range of self-reported psychological and goal achievement variables, as well as several academic outcomes, described in sections 5.4.1 and 5.4.4, respectively. In addition to these, a derived variable—cohort (i.e., whether participants were in Grade 7 or Grade 8 at the start of the study)—was included. Table 6.1 (p. 121) provides an overview of the participants' demographic characteristics at the baseline.

As Boehnke (1996) noted, a monograph faces a dilemma when presenting information about instruments, or, as in this case, preparatory analyses (e.g., dimension reduction via factor analysis) used to refine instruments for the main analyses: either include all details in the text or relegate much of the information to the Appendix. I have opted to include these details in the main text; however, readers less interested in psychometric details might choose to skip sections 6.4, 6.5, and all but the final paragraph of section 6.6.

6.1 Handling of Missing Data

The sample for this study comprised 208 middle school students. At Time 1 (T1, pre-intervention), missing data for self-report variables ranged from 0.5% (SEA proxy variables, $n = 207$) to 1.9% (mindset, $n = 204$). At Time 2 (T2, eight months post-intervention), attrition reduced the sample size by 14 participants, leading to higher missing data rates for self-report measures, from 6.7% ($n = 194$, e.g., conscientiousness, school self-control, school self-efficacy) to 8.2% ($n = 191$, mindset). The school and personal goal achievement variables had substantially higher missing data rates due to non-responses at T1 and T2 (e.g., 78 participants failed to name an important short-term *personal* goal at T1). Missing data for students' grades across five assessment points, provided by the school at the end of each half-year term, ranged from 6.3% – 9.6% ($n = 195$ to $n = 188$). Students who had just transferred from another school, those attending a beginner-level intensive German language course, and special needs students did not receive regular school marks. Finally, teacher evaluations (T2) were missing for three students, and educational attainment five years post-intervention could be verified for 93.3% of the original sample.

I have chosen not to impute data for any of the variables listed above. For self-report variables at T1 and teachers' evaluations at T2, where an average of 1.2% of the data is missing at random, the effort and complexity of imputation procedures are not justified, as their benefits do not outweigh the straightforwardness of listwise deletion (Graham, 2009).

Table 6.1*Sociodemographic Characteristics of Participants at Baseline*

	Condition								Total	
	AM		AM + LSS		LSS		Control group			
Characteristic	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Cohort										
Grade 7	17	43.6%	20	37.0%	36	59.0%	14	25.9%	87	41.8%
Grade 8	22	56.4%	34	63.0%	25	41.0%	40	74.1%	121	58.2%
Total (Cohort)	39	100%	54	100%	61	100%	54	100%	208	100%
Gender										
Male	17	43.6%	28	51.9%	37	60.7%	31	57.4%	113	54.3%
Female	22	56.4%	26	48.1%	24	39.3%	23	42.6%	95	45.7%
Total (Gender)	39	100%	54	100%	61	100%	54	100%	208	100%
SEA										
Low SEA	13	33.3%	19	35.8%	13	21.3%	12	22.2%	57	27.5%
Medium SEA	17	43.6%	21	39.6%	31	50.8%	30	55.6%	99	47.8%
High SEA	9	23.1%	13	24.5%	17	27.9%	12	22.2%	51	24.6%
Total (SEA)	39	100%	53	100%	61	100%	54	100%	207	100%

Note. Participants were on average 13.5 years old ($SD = 0.708$). Age and gender did not differ significantly by condition; AM = Academic Mindsets, LSS = Learning Skills & Strategies

Imputation for self-report measures at T2, however, poses greater risks. Since attrition often occurs for non-random reasons, such as students dropping out due to poor performance, imputing values could distort the trajectory of change by assuming patterns that do not exist for those who left the study (Graham, 2009). Listwise deletion, while reducing the sample by up to 8% in repeated measures analyses, maintains the integrity of the longitudinal data.

For goal-related variables, missing data typically arises because some students did not name goals at T1 and therefore did not assess their progress at T2. Inferring goal achievement for students who did not set goals introduces false data points where they should not exist. Excluding these cases leads to a substantial loss of data, regrettably, but respects the natural structure of the data and ensures that only relevant cases are included in the analysis.

When it comes to students' grades, the main dependent variable (DV), imputing missing values is problematic for several reasons. For imputation to be valid, the data is often assumed to be missing at random, but grades are missing due to systematic reasons (e.g., special needs, language barrier). Moreover, imputing missing data for a non-trivial percentage of cases (< 10%) could falsely inflate the performance metrics. Instead, analyzing the available data using listwise deletion can provide more reliable results, avoiding risks associated with speculative imputation.

Lastly, students whose educational attainment data is missing, largely due to non-

random reasons such as dropout or relocation (~ 6.7%), might differ systematically from students whose attainment is known. Imputation in this case may not reliably predict outcomes for those with missing data, compromising the validity of the analyses.

Although listwise deletion reduces the sample size and statistical power and leads to variations in participant numbers across analyses, it safeguards the integrity of the data. The variations, while potentially limiting generalizability, are a natural consequence of the study's design and data collection process and are unlikely to distort the study's overall conclusions.

6.2 Handling of Outliers

A non-trivial proportion of extremely low scores (5.6% to 7.7%) was observed for school belonging and two variables related to maintaining interest in and confidence about achieving a self-selected school-related goal. Upon review, these scores appear legitimate, reflecting genuine differences among participants, such as low school belonging or reduced interest/confidence in prior goals. While these outliers might affect the results, their inclusion is important for capturing the full range of variability within the sample. To mitigate their potential influence, bootstrapping was employed wherever possible. According to Davison and Hinkley (1997), bootstrap methods are well-suited for handling data with outliers, as they provide robust estimates and confidence intervals by 'diluting' the disproportionate impact of extreme values across many resampled datasets. This approach can be used as a diagnostic tool to assess the stability of statistical estimates in the presence of outliers.

6.3 Testing of Data Assumptions

Before conducting any analyses, I assessed the normality of distribution for all variables using the Kolmogorov-Smirnov test (see section 6.4 below, and relevant sections throughout Chapters 7 and 8) and have taken steps to increase robustness for analyses involving measures that do not meet the assumption of normality. Additionally, I relied on SPSS built-in diagnostics to evaluate other assumptions, including homoscedasticity (Box's *M* test), homogeneity of variance (Levene's test), sphericity (Mauchly's test), and multicollinearity (VIF and tolerance levels). This approach has allowed me to streamline the workflow without compromising rigor. Assumption violations are discussed and addressed (where possible) when reporting the findings of specific analyses in the next two chapters.

6.4 Dimensionality and Construct Validation for Self-Report Variables Other than Grit

Internal consistency reliability, Exploratory Factor Analysis (EFA) and, where necessary, Confirmatory Factor Analysis (CFA) were utilized to refine and reduce the scales, ensuring that they accurately represent the underlying constructs. For an overview of T1 / T2 internal consistency coefficients and test-retest correlations, please see Table 6.2 (p. 130).

Conscientiousness. The internal consistency of the two-item conscientiousness scale at T1 was assessed using Cronbach's alpha (α), yielding a value of .454 ($\alpha_{\text{std}} = .480$ for standardized items). While this value falls below the conventional threshold for internal consistency, it is important to note that the two items—'Ich bin eigentlich eher faul' (I am rather lazy) and 'Ich erledige Aufgaben gründlich' (I complete tasks thoroughly)—were designed to capture distinct facets of conscientiousness, as evidenced also by their moderate inter-item correlation ($r = .315, p < .001$). The strong correlations with the composite conscientiousness score, calculated as an average of the two items ($r = .883$ and $r = .724$, respectively, $p < .001$) suggest that while the items are not highly similar, they both contribute meaningfully to the broader construct. At T2, similar results were observed ($\alpha = .464, \alpha_{\text{std}} = .485$, inter-item correlation $r = .320, p < .001$), and a composite score was likewise calculated.

It is worth noting that the two-item conscientiousness scale is part of the 10-item version of the Big Five Inventory (BFI-10), for which reliability, construct validity, and external validity have been demonstrated using methods such as factorial structure, test-retest reliability, and item-total correlations (Rammstedt et al., 2013). The decision to use the composite score, despite the lower alpha values, aligns with the established practice in studies relying on the BFI-10, where each pair of items assesses a single dimension of personality.

School Belonging. The three-item school belonging scale exhibited poor initial internal consistency at T1 ($\alpha = .380, \alpha_{\text{std}} = .404$), which would increase to .574 by removing one item. The problematic item, 'Ich fühle mich in meiner Schule zu Hause' (I feel at home in my school, $M = 2.36, SD = 1.178$) appears to capture a different aspect of belonging than the other two items, 'Die Leute in meiner Schule akzeptieren mich' (People in my school accept me, $M = 4.01, SD = 1.022$) and 'Ich fühle mich in meiner Schule als Außenseiter' (I feel like an outsider at my school; reverse-coded, $M = 4.50, SD = .932$), as evidenced by its substantially lower mean. The original phrasing of the item in English was "I feel like I belong in my school" (Layous et al., 2017, p. 228). Its translation into German for the current study was cross-checked by two German native speakers, but it is certainly possible that 'feeling at home' was interpreted quite literally, which could explain why a majority of students scored low on this item.

The other two items, although representing opposite and, in my view, mutually exclusive aspects of school belongingness (feeling accepted vs. feeling like an outsider, with the latter reverse-coded), were not as closely related as anticipated, showing only a moderate positive inter-item correlation ($r = .404, p < .001$). Unlike the translation of the first item, the German versions of these two items matched the English original word-for-word. The size of

the correlation might be explained by the second item's oppositional phrasing or the use of the term 'outsider', which could carry different connotations in German or be too abstract for teenagers. The original scale, with a Cronbach's α of .85 in Layous et al. (2017), was validated on college students, who likely have more advanced abstract thinking skills than the teenagers in this sample. College students may have interpreted the items less literally, whereas younger participants might have struggled with concepts like being accepted / being an outsider, which could have affected their responses and, consequently, the scale's reliability. Therefore, I discarded the 'feeling at home' item (new $\alpha = .574$) and calculated a composite school belonging score by averaging the remaining two items, which contribute meaningfully to measuring the latent construct (item-total correlations $r = .854$ and $r = .821$, respectively, $p < .001$) despite their moderate inter-item correlation.

At T2, the initial α value for the three-item school belonging scale was also below acceptable levels ($\alpha = .286$; $\alpha_{\text{std}} = .324$) and increased to .637 by removing the 'feeling at home' item. The two remaining items had a moderate inter-item correlation ($r = .467$, $p < .001$) and very high item-total correlations with the school belonging composite score.

School Self-Control. The four-item school self-control scale demonstrated acceptable internal consistency at T1 ($\alpha = .739$, $\alpha_{\text{std}} = .749$), which would not improve by deleting any item. An EFA using Maximum Likelihood⁹⁸ was conducted to assess the underlying structure of the four-item scale. It revealed a single-factor solution, which explained 44.07% of the total variance. Factor loadings were acceptable for all items, ranging from .512 to .794. The Chi-Square Test for Model Fit was on the threshold of significance ($\chi^2(2) = 5.981$, $p = .050$), suggesting that there may be a slight discrepancy between the observed data and the model-implied data. As a result of this finding, a CFA using Maximum Likelihood Estimation was conducted to validate the factor structure identified in the EFA. The single-factor model fit the data well, with a chi-square value of 3.879 ($df = 2$, $p = 0.144$), a normed chi-square (CMIN/DF) value of 1.940, a Comparative Fit Index (CFI) of .987, a Tucker-Lewis Index (TLI) of .935, and a Root Mean Square Error of Approximation (RMSEA) of .071. These fit indices suggest that the single-factor model adequately represents the data, confirming the unidimensionality of the scale.

⁹⁸ The Maximum Likelihood (ML) is unique among extraction methods in that it allows for the estimation of goodness-of-fit statistics, which provides a comprehensive evaluation of the model's adequacy in representing the data. Additionally, ML is relatively robust to slight and moderate violations of normality, making it a flexible option for the current dataset (Costello & Osborne, 2005). Finally, using ML in EFA aligns methodologically with Confirmatory Factor Analysis (CFA), facilitating a smoother transition and comparability between exploratory and confirmatory phases. These considerations make ML an appropriate extraction method for the current study.

At T2, the internal consistency for the four school self-control items was slightly higher ($\alpha = .775$), and the subsequent EFA returned a single-factor model explaining 47.67% of the total variance, with a non-significant chi-square test and factor loadings above .618.

School Self-Efficacy. The five-item school self-efficacy scale showed acceptable internal consistency ($\alpha = .776$, $\alpha_{std} = .778$), which would not improve by deleting any item. The subsequent EFA revealed a single-factor solution explaining 42.15% of the total variance, with factor loadings ranging from .472 to .721. The significant chi-square test ($\chi^2(5) = 13.297$, $p = .021$) indicated potential issues with model fit, prompting a CFA to evaluate the single-factor model. The model showed acceptable fit indices: CMIN/DF = 2.445, TLI = .901, CFI = .967, and RMSEA = .088. While the chi-square statistic ($\chi^2(5) = 12.226$, $p = .032$) remained significant, this result is likely due to its sensitivity to sample size and does not necessarily reflect poor fit, as other indices support the model's adequacy. All items loaded significantly onto the single factor, confirming the model's suitability for capturing the intended construct.

The five-item school self-efficacy scale at T2 displayed good internal consistency ($\alpha = .803$), and the EFA yielded a single-factor solution explaining 46.15% of the total variance, with a non-significant chi-square test and factor loadings ranging between .553 and .789.

Mindset. The implicit theories of intelligence / mindset scale, consisting of three items, demonstrated good internal consistency at T1, with a Cronbach's α of .858. Although removing one item would increase the alpha value from .858 to .868, this improvement is minimal and does not justify altering an established scale. Moreover, maintaining the full scale ensures consistency with prior research, enabling meaningful comparisons across studies. Therefore, the item was retained to preserve the integrity and comprehensiveness of the scale. The EFA revealed a single-factor solution explaining 68.03% of the total variance, with factor loadings ranging from .706 to .924. No chi-square test is returned for a three-item scale because the model is just-identified, meaning there are exactly enough parameters to perfectly reproduce the observed correlations. The results of the EFA indicate that the single-factor model fits the data very well.

These results apply also to the three-item mindset scale at T2, which exhibited good internal consistency ($\alpha = .891$), an even higher percentage of total explained variance for the single-factor model (74.41%), and factor loadings between .776 and .926.

School Engagement. The six-item behavioral school engagement scale showed questionable internal consistency at T1, with an initial Cronbach's α of .578 that improved to .637 after removing an item related to skipping school. This item was problematic, as skipping school is rare in Grades 7 and 8 and did not align with other academic behaviors,

such as doing homework or participating in class. The initial EFA faced several issues, including low factor loadings, double loadings, and a two-factor solution explaining only 31% of the total variance. After removing the skipping school item, the EFA yielded a single-factor solution that explained 30.32% of the total variance, with factor loadings ranging from .371 to .739 and a non-significant chi-square test, $\chi^2(5) = 6.027, p = .304$. Given the low total variance explained by this factor and two factor loadings slightly below the .4 threshold, I conducted a CFA that indicated a good model fit ($\chi^2(5) = 7.354, p = .196$, CMIN/DF = 1.471, TLI = .939, CFI = .980, RMSEA = .050), with all five items loading significantly onto the single factor, as evidenced by significant regression weights. These findings indicate that the revised five-item scale captures the construct adequately, with good overall fit.

The corresponding T2 scale had an initial Cronbach's α of .621, which increased to .641 after removing the skipping school about. The reduced scale's EFA yielded a single-factor model explaining 30.43% of the variance, with acceptable factor loadings except for one item (.331) and a non-significant chi-square test. A subsequent CFA demonstrated acceptable fit ($\chi^2(5) = 10.622, p = .059$, CMIN/DF = 2.124, TLI = .913, CFI = .956, RMSEA = .077) with a highly significant ($p < .001$) regression weight for the item with lower EFA loading, justifying its retention.

Goal Achievement. Four items related to school goal achievement and four related to personal goal achievement were measured only at T2 (post-intervention). Students were reminded of the goals they had set eight months earlier and were asked to reflect on various aspects of goal achievement: goal importance ('This goal is still important to me'⁹⁹), goal-directed effort ('How much have you done so far to achieve this goal?'¹⁰⁰), goal progress ('To what extent have you already achieved this goal?'¹⁰¹), and goal-achievement confidence ('If you are currently still working toward this goal, do you think you can still achieve it?'¹⁰²).

Although these aspects of goal achievement are relatively distinct, I attempted to reduce the scales in the same way I had with the previous measures. Cronbach's α for the four-item school goal scale was .605 ($\alpha_{\text{std}} = .613$) and would increase to .700 by discarding the goal importance item. The four-item personal goal scale had a Cronbach's α of .654 ($\alpha_{\text{std}} = .669$), which would increase to .715 upon removal of the goal importance item. Descriptive statistics indicated that the distribution of scores for the school goal importance item was

⁹⁹ German version: 'Dieses Ziel ist mir immer noch wichtig'

¹⁰⁰ German version: 'Wie viel hast du bisher getan, um dieses Ziel zu erreichen?'

¹⁰¹ German version: 'Inwieweit hast du dieses Ziel bereits erreicht?'

¹⁰² German version: 'Falls du derzeit immer noch Mühe und Zeit in dieses Ziel steckst, glaubst du, dass du es noch erreichen kannst?'

negatively skewed (skewness = -1.803, $SE = 0.183$) and exhibited positive kurtosis (kurtosis = 2.850, $SE = 0.364$). Tests of normality confirmed that the distribution deviated from normality (Shapiro-Wilk $W = 0.672$, $p < .001$; Kolmogorov-Smirnov $D(176) = 0.346$, $p < .001$). The other three items, whose skewness and kurtosis were closer to zero, also failed normality tests, as did the personal goal variables. Given the significant deviations from normality, Principal Axis Factoring (PAF)—which is more robust to non-normal distributions—was selected for the goal achievement EFAs¹⁰³.

The EFA for students' self-selected *school* goal that included all four items extracted a single factor explaining 34.79% of the total variance, but the loading for the goal importance item was only .177, whereas the other three loadings exceeded .58. After discarding this item, the EFA revealed a single-factor solution explaining 45.66% of the total variance, with factor loadings ranging from .575 to .786. While this result was encouraging, I also evaluated the Keiser-Meyer-Olkin (KMO) measure of sampling adequacy, which had a mediocre but still acceptable value of .659¹⁰⁴, and Bartlett's test of sphericity, which was highly significant ($p < .001$), indicating that the correlations between items are sufficiently large for factor analysis.

When all four items were included, the EFA for students' self-selected *personal* goal extracted one factor that explained 37.79% of the total variance. Mirroring the previous analysis, the loading for the goal importance item was only .289, while the other loadings exceeded .60. The EFA excluding this item returned a single-factor solution explaining 49.84% of the variance, with loadings ranging from .570 to .891. The KMO measure was also mediocre but acceptable (.639) and Bartlett's test of sphericity was highly significant ($p < .001$), suggesting that the three personal goal items are sufficiently highly correlated.

These findings provided ample support for the existence of underlying constructs for both school and personal goal achievement. Nonetheless, the items are conceptually distinct, each capturing unique aspects that might be obscured in analyses using only the EFA-derived factor score for the reduced (3-item) scales. Hence, in addition to using the goal importance variables and factor scores as *distinct* DVs, all four school goal items (and all four personal goal items) were also analyzed separately in a MAN(C)OVA. This approach assesses whether the effects are consistent across the broader constructs and their individual components.

German Proficiency. The three German proficiency items (translating to 'How well do you read in German?', 'How well do you write in German?', and 'How often is German

¹⁰³ I conducted a robustness check by performing the EFA also with the ML extraction method and it returned almost identical results in terms of factor structure, total variance explained, and factor loadings. This suggests that the findings are not dependent on the choice of extraction method.

¹⁰⁴ Values closer to 1 indicate that the data are more suitable for factor analysis.

spoken in your home?') showed acceptable internal consistency at T1 ($\alpha = .639$), which would increase to .733 by removing the third item. An EFA (ML extraction) returned a single-factor model explaining 48.53% of the total variance, with high loadings for the first two items (.965 and .600) and a lower loading for the third item (.405). Given this item's weaker correlation with the other two items ($r = .243$ and $r = .391$, $p < .001$), its conceptual difference from reading and writing abilities, and the significant improvement in Cronbach's α if it were removed, I excluded it and calculated a composite German proficiency score by averaging the first two items. The inter-item correlation of the *ability* variables was much higher ($r = .581$, $p < .001$), and the item-total correlations with the composite score ($r = .884$ and $r = .894$, $p < .001$) further supported this two-item measure.

At T2, the item about the frequency of German use at home performed markedly worse, with α increasing from .594 to .757 upon its removal. The item also correlated weakly with the two ability items ($r = .282$ and $r = .230$, $p < .001$) and had a low EFA factor loading (.326). Thus, it was excluded prior to calculating the composite German proficiency score.

Books at Home. Finally, the two items assessing the number of books students personally own and the total number of books at home demonstrated good internal consistency at T1 ($\alpha = .724$) and T2 ($\alpha = .722$) and were averaged to create a composite score.

Index of Socio-Educational Advantage. Using indicators like the number of books at home as proxies for SES is common in educational research, as this measure often correlates more strongly with learning outcomes than family income, parental education, or occupation (for an overview and a specific application in the German context, see Heppt et al., 2022). Similarly, language proficiency is often used as a proxy for migration background, in particular (see Dian & Triventi, 2021 for an example in German secondary education), and for SES, in general, as language barriers can hinder social integration, educational attainment, employment opportunities, and access to services—all of which are central aspects of SES.

As the German proficiency and books at home variables capture family characteristics related to parental education, parental engagement, the home literacy environment, cultural capital, and German language proficiency—all of which influence a child's opportunities and success in the German educational system—I refer to them as a measure of socio-educational advantage (SEA). Children with high SEA scores benefit from both social and educational advantages, while lower scores indicate comparative disadvantage. The term draws inspiration from the Index of Community Socio-Educational Advantage (ICSEA), a school-level measure used in Australia, which incorporates information about students (parental education and occupation, family language background) and school-related factors (share of

indigenous students, remoteness, and percentage of students with a language background other than English, who are considered disadvantaged) (ACARA, 2023). Although ‘my’ SEA is a simpler, individual-level measure, it shares conceptual similarities with ICSEA.

To create the SEA Index, I combined the *z*-standardized composite scores for German proficiency and books-at-home at T1¹⁰⁵. This method ensures that scores from different distributions are comparable and that both variables contribute equally to the SEA Index.

Considerable thought was given to the pertinence and justifiability of an index measure. The bivariate correlation between the German proficiency and the books-at-home *composite* variables at T1 was weak ($r = .211, p < .001$). To explore whether these composite variables might reflect a latent construct, I assessed their internal consistency, similar to how one would evaluate a two-item scale, and found that it was low (Cronbach’s $\alpha = .348$). Nonetheless, there is significant value in constructing a SEA Index. Much like facets of a broader construct such as conscientiousness, which may not be highly correlated but collectively contribute to a comprehensive understanding of the construct, these variables measure distinct facets of socio-educational advantage and hopefully reflect a ‘whole’ that is greater than the sum of its parts.

The true value of this new SEA Index is demonstrated by its strong predictive validity for outcomes traditionally related to SES, such as students’ GPA (see RQ 2a, 2b, and 2c). Moreover, as a predictor, it outperforms its separate components, explaining more variance in students’ GPA at T1 than the combination of German proficiency and books-at-home ($R^2 = .182$ vs. $R^2 = .170$).

For all scales discussed above that consist of at least three items, Bartlett factor scores¹⁰⁶ based on the single factor identified in the EFA were computed, saved, and used in subsequent analyses. To facilitate interpretation and comparability across variables, I also mean-centered the two-item composite scores, such as those for conscientiousness or school belonging. This process aligns the two-item composite scores with the factor scores, ensuring all variables have a mean of zero. In addition, mean-centering can help reduce multicollinearity, particularly when multiple predictors in regression analyses are highly correlated (as grit and its nomological neighbors are), and it makes the interpretation of

¹⁰⁵ Given that 207 out of 208 participants provided answers on the German proficiency and books-at-home items at T1, compared to 193 at T2, the SEA Index was calculated solely for T1. This decision is both practical and theoretically sound, as I need students’ SEA at T1 as a covariate or moderator in subsequent statistical analyses. Moreover, it is unlikely that a student’s socio-educational advantage would undergo significant change within eight months.

¹⁰⁶ The Bartlett method was chosen because it provides unbiased estimates that minimize the error variance between the estimated and true factor scores. This method is particularly suitable when precision in factor score estimation is required for further analyses (DiStefano et al., 2009).

Table 6.2*Internal Consistency and Test-Retest Correlations for Latent Variables other than Grit (T1, T2)*

	α (T1)	α (T2)	r (T1, T2)	n (T1)	n (T2)	n (r)
Conscientiousness (2 items)	.454	.464	.663**	205	194	193
School belonging (2 items)	.574	.637	.507**	206	193	192
School self-control (4 items)	.739	.775	.478**	205	194	193
School self-efficacy (5 items)	.776	.803	.492**	206	194	193
Mindset (3 items)	.858	.891	.455**	204	191	189
School engagement (5 items)	.637	.641	.577**	205	193	192
School goal achievement (3 items)	—	.700	—	—	177	—
Personal goal achievement (3 items)	—	.715	—	—	118	—
German proficiency (2 items)	.733	.757	.671**	207	193	192
Books at home (2 items)	.724	.722	.786**	203	191	190

Note. Bootstrapping was used for correlation coefficients to ensure robustness. Bootstrap results are based on 1000 bootstrap samples.

** Correlation is significant at the 0.01 level (2-tailed).

regression coefficients more straightforward. Four additional variables—gender, cohort, teachers' evaluation of student progress at T2 ($n = 205$), and students' educational attainment five years post-intervention ($n = 194$)—were measured using single items and were not further preprocessed due to their categorical nature.

6.5 Dimensionality and Construct Validation for General Grit and School Grit

The factor analyses conducted on the two grit scales served a dual purpose: first, to reduce dimensions, as was done with the variables described earlier; and second, to evaluate the structural validity of grit. Grit's factor structure has been a subject of considerable debate in the literature on the psychometric properties of original and transadapted grit measures (e.g., Abu Hasan et al., 2022; Credé, 2019; Credé et al., 2017; Duckworth et al., 2021; Guo et al., 2019; Jachimowicz et al., 2019; Schmidt et al., 2019). As discussed in section 2.5.2, although grit is hypothesized to have a two-dimensional higher-order structure, researchers have identified various factorial solutions. These include a single unidimensional factor, two correlated lower-order factors, hierarchical models with two lower-order factors and an overarching latent grit construct, bifactor models, as well as three- or four-factor models for adapted scales.

Domain-General Grit. At T1, the eight-item domain-general grit scale demonstrated nearly acceptable internal consistency (Cronbach's $\alpha = .694$). The four-item subscales for consistency and perseverance had alphas of .654 and .687, respectively, which is a somewhat

better result given the smaller number of items per subscale. The EFA¹⁰⁷ yielded a two-factor solution explaining 37.99% of the total variance, supporting the two-dimensional structure of grit. All perseverance items loaded onto the first factor (loadings: .442 to .772), all consistency items loaded onto the second factor (loadings: .526 to .628), and the chi-square test for this two-factor model was non-significant, $\chi^2(13) = 19.478, p = .109$. Separate EFAs for the subscales confirmed their internal consistency, with all items loading well onto their respective single factors.

The follow-up CFAs first evaluated consistency and perseverance separately to confirm their validity as distinct scales for independent use in subsequent analyses. This separate usage is common among grit researchers, both those interested in the unique predictive value of each facet and those who reject grit's hierarchical structure. Subsequently, a CFA modeled perseverance and consistency as correlated lower-order factors within a second-order latent grit construct.

The CFA for the general consistency subscale revealed an excellent fit to the data, with $\chi^2(2) = 0.187, p = .911$, CMIN/DF = 0.094, CFI = 1.000, RMSEA = .000, and TLI slightly above 1.000¹⁰⁸. These indices suggest the model fits the dataset almost perfectly. However, this near-perfect fit should be interpreted cautiously, as it may reflect a simple model that doesn't require much flexibility to achieve a good fit and might not generalize equally well to other samples where the relationships between variables are more complex. The CFA for the general perseverance subscale also showed a good fit, with $\chi^2(2) = 3.387, p = .184$, CMIN/DF = 1.693, CFI = .990, TLI = .950, and RMSEA = .058. All factor loadings were significant, providing strong evidence of the perseverance subscale's construct validity.

When examining the theoretical higher-order structure of general grit using CFA, several researchers, including Duckworth and Quinn (2009), have reported unequal loadings of the first-order factors onto the second-order factor. This suggests they did not impose the equality constraints necessary for higher-order model identification, as highlighted by Credé et al. (2017) and later acknowledged by Duckworth et al. (2021). Importantly, imposing such constraints would result in a hierarchical model with identical fit to a non-hierarchical model where perseverance and consistency are treated as two correlated constructs.

Thus, comparing the two models using standard fit indices is not meaningful. However, medium-to-high correlations between the two grit dimensions and significant

¹⁰⁷ Extraction method: Maximum Likelihood. Rotation method: Varimax with Kaiser Normalization.

¹⁰⁸ While a TLI above 1 is mathematically possible, it suggests that the model fits the data exceptionally well, perhaps too well, raising concerns about overfitting, model simplicity, or small sample size. Such a TLI value is usually reported as 1.000.

loadings of the first-order latent variables onto the second-order grit factor would suggest that a higher-order construct is plausible (Credé et al., 2017). Moreover, if the hierarchical model exhibits greater predictive power than the individual facets—especially when the shared variance captured by the overall score is more relevant to the outcome—this would justify aggregating grit’s dimensions.

Accordingly, the two models showed identical fit, with acceptable indices: $\chi^2(19) = 37.849$, $p = .006$; CMIN/DF = 1.992; TLI = .866; CFI = .929; and RMSEA = .070. The CFA-estimated correlation between the subscales was .346, with a significant covariance ($p = .003$), indicating that the subscales are related but distinct. Both lower-order factors loaded significantly onto the higher-order factor, with a standardized regression weight of .588 ($p < .001$), suggesting the higher-order factor is moderately well-defined by the subscales, though it may not be as robust as desired. While the overall grit factor score derived from the hierarchical model¹⁰⁹ is certainly valid for further analyses, it may not capture the nuances of the underlying data fully.

At T2, the internal consistency of the complete general grit scale was lower than at T1, with a Cronbach’s α of .639. This result is explained by the lower reliability of the general consistency subscale ($\alpha = .577$), given that the perseverance subscale performed considerably better than at T1 ($\alpha = .786$). The EFA for general grit at T2 revealed a two-factor structure consistent with the theoretical model, with consistency items loadings between .397 and .625 and perseverance items loadings between .526 and .856. The model fit was good, as indicated by a non-significant chi-square statistic ($p = .682$). Separate EFAs confirmed the subscales’ internal consistency, with the perseverance subscale standing out by explaining 51.22% of the total variance—a notably higher proportion than observed in previous grit analyses.

Just like at T1, the CFA results for the general consistency subscale at T2 indicated a near-perfect model fit. The very low chi-square value and high p -value ($\chi^2(2) = 0.405$, $p = .871$) suggest no significant difference between the model and the observed data. Additional indices (CMIN/DF = .203, CFI = 1.000, TLI = 1.000, RMSEA = .000) confirmed an exceptionally good fit. However, as discussed earlier, such results may reflect overfitting, an overly simplistic model, or sample-specific characteristics that limit generalizability. For the general perseverance subscale, the CFA demonstrated a reasonably good fit, with CFI = .987,

¹⁰⁹ Although Duckworth et al. (2021) “recommend using the sum of both subscales” when measuring the construct of grit (p. 574), saving CFA-derived factor scores for the hierarchical model with an equality constraint offers several advantages: accounting for measurement error associated with each item, accurately reflecting the underlying hierarchical structure, and providing higher construct validity because the scores are derived from a model that has been tested and confirmed to fit the data.

TLI = .937, RMSEA = .089, and CMIN/DF = 2.510, all within acceptable ranges. The highly significant item loadings ($p < .001$) confirmed that each item contributed meaningfully to the perseverance construct, which strengthens the overall validity of the model.

Unlike at T1, however, the higher-order factor structure for general grit was *not* supported by the data. While the correlated first-order factor model and the hierarchical model with a higher-order grit factor demonstrated a truly excellent fit ($\chi^2(19) = 25.799$, $p = .136$; CMIN/DF = 1.358; CFI = .978; TLI = .958; RMSEA = .043), the CFA-estimated correlation between the two subscales was negative and negligible ($r = -.025$, covariance $p = .798$). Additionally, the two dimensions did not load at all onto a higher-order general grit factor ($\beta = .000$, $p = 1.000$). These results suggest that although the two-factor model adequately captures the structure and relationships among the observed variables, the two grit subscales are essentially independent of one another at T2, rendering the inclusion of a second-order latent variable unwarranted¹¹⁰.

Moreover, the CFA-estimated correlation between the subscales shifted dramatically between measurement points—from a moderate, significant correlation at T1 ($r = .346$) to a negligible, non-significant correlation at T2 ($r = -.025$). This denotes that the relationship between the dimensions of grit may be unstable or context-dependent, particularly in a longitudinal framework. The relatively low test-retest bivariate correlations for the subscales ($r = .373$ for perseverance and $r = .383$ for consistency, $p < .001$) further support this interpretation. These correlations imply that the measurements of general grit at T1 and T2 within the same sample are less consistent than expected. They may also point to potential measurement issues at T2, suggesting that the scale might not be sufficiently reliable or valid in capturing grit consistently over time. Together, these findings cast doubt on the legitimacy and stability of the higher-order domain-general grit construct. Please refer to Table 6.3 (p. 134) for an overview of the internal consistency and test-retest reliability for domain-general and school-specific grit scales.

School-Specific Grit. The internal consistency of the complete school grit scale at T1 was higher than that of the domain-general scale ($\alpha = .748$), and would improve marginally (+.021) by removing one of the four school perseverance items¹¹¹. The school consistency subscale also performed better than its domain-general counterpart ($\alpha = .698$), whereas the school perseverance subscale had a slightly lower coefficient than the general perseverance

¹¹⁰ When saving CFA-derived factor scores, the software did not even generate scores for the overall grit construct, only for the subscales of perseverance and consistency.

¹¹¹ ‘Von Rückschlägen (Niederlagen) in der Schule lasse ich mir nicht den Mut nehmen’ (I don’t let setbacks (defeats) at school discourage me).

Table 6.3*Internal Consistency and Test-Retest Correlations for General and School-Specific Grit (T1, T2)*

	α (T1)	α (T2)	r (T1, T2)	n (T1)	n (T2)	n (r)
Grit (general, 8 items)	.694	.632	–	205	–	–
Perseverance (general, 4 items)	.687	.786	.373**	205	192	191
Consistency (general, 4 items)	.654	.577	.383**	205	192	191
Grit (school, 8 items)	.748	.800	.657**	205	192	191
Perseverance (school, 4 items)	.666	.734	.665**	205	192	191
Consistency (school, 4 items)	.698	.728	.548**	205	192	191

Note. Bootstrapping was used for correlation coefficients to ensure robustness. Bootstrap results are based on 1000 bootstrap samples.

** Correlation is significant at the 0.01 level (2-tailed).

scale ($\alpha = .666$). Item analysis revealed that removing the ‘setbacks’ item from the school perseverance subscale would improve its internal consistency considerably ($\alpha = .764$).

The EFA with all eight items yielded a two-factor solution explaining 41.04% of the total variance. All items loaded as theorized except for the problematic ‘setbacks’ item, which did not meet the .4 threshold. Relaxing the threshold to .2 allowed it to load onto the ‘correct’ factor (.243), but resulted in double loadings for three other items. The separate EFA for the school consistency subscale, despite a significant chi-square statistic, revealed that the four consistency items load onto a single factor (loadings: .498 to .787), explaining 38.19% of the total variance. For the school perseverance subscale, the EFA also identified a single factor explaining 41.80% of the variance. However, the ‘setbacks’ item’s loading was only .253.

Follow-up CFAs tested the school consistency and perseverance subscales individually and the hypothesized hierarchical model of school grit. Although all four consistency items loaded significantly ($p < .001$) onto the latent school consistency variable, the overall model fit was poor (CMIN/DF = 4.765; CFI = .947; TLI = .842; RMSEA = .136). In contrast, the CFA for the school perseverance subscale indicated an almost perfect model fit (CFI = 1.000, TLI = 1.000, RMSEA = .000), which should be interpreted cautiously. The ‘setbacks’ item had a substantially lower standardized regression weight (.254) and a slightly less significant p -value (.002) than the other items, indicating weaker alignment with the school perseverance construct.

Finally, the CFA with a second-order factor and an equality constraint revealed a remarkably good model fit: $\chi^2(19) = 32.468$ ($p = .028$), CMIN/DF = 1.709, CFI = .962, TLI = .928, RMSEA = .059. The CFA-estimated correlation between the subscales was moderate (.571, covariance $p < .001$) and the ‘setbacks’ item’s loading was significant, despite

remaining low ($\beta = .259, p = .001$). The two first-order factors loaded onto the higher-order factor with a high standardized regression weight of $.756 (p < .001)$, supporting the robustness of the higher-order model.

To sum up, while the school grit subscales exhibited limitations in both EFAs and CFAs, the higher-order factor model proved robust, suggesting that the combined subscales capture the overall school grit construct better. The CFA-derived overall grit factor score is likely more appropriate for further analyses than the separate subscale scores. Retaining the 'setbacks' item, despite its weaker performance, preserves the integrity of the scale and ensures comparability across studies, which is crucial for consistency in grit research.

Overall school grit at T2 demonstrated good internal consistency, with $\alpha = .800$, the highest among all grit scales and subscales. Both four-item subscales at T2 exhibited adequate internal consistency ($\alpha = .734$ for perseverance and $\alpha = .728$ for consistency), though the perseverance subscale's alpha would improve noticeably without the 'setbacks' item ($+ .070$). An EFA of the eight school grit items produced a theory-consistent two-factor model explaining 45.59% of the variance, but the 'setbacks' item failed to meet the $.4$ loading threshold. Separate EFAs revealed that the school consistency subscale had a non-significant chi-square statistic and items loading well onto a single factor, explaining 42% of the total variance. In contrast, the school perseverance subscale showed a significant chi-square ($p = .002$), and the loading of the problematic item was only $.308$.

The subsequent CFAs for school consistency and perseverance at T2 reversed the patterns observed at T1. Consistency showed a near-perfect fit ($\text{CMIN/DF} = .378, \text{CFI} = 1.000, \text{TLI} = 1.000, \text{RMSEA} = .000$), whereas perseverance exhibited a poor fit despite all four items loading significantly ($p < .001$) onto the latent variable and despite a good CFI value ($.955$): $\chi^2(2) = 12.234 (p = .002)$, $\text{CMIN/DF} = 6.117, \text{TLI} = .775, \text{RMSEA} = .163$.

Mirroring the results at T1, however, the hierarchical model for school grit at T2 showed an undeniably excellent fit: $\chi^2(19) = 25.546 (p = .143)$, $\text{CMIN/DF} = 1.345, \text{CFI} = .985, \text{TLI} = .971, \text{RMSEA} = .042$. The two subscales had a CFA-estimated correlation of $.627$ (covariance $p < .001$), with both subscales loading significantly and strongly ($\beta = .792$) onto the higher-order school grit factor. This denotes that the latent school grit variable remains robust and adequately captured by its subscales also at T2, despite the observed limitations in the individual subscale analyses. Consequently, the CFA-derived school grit factor score is also a valid measure of the overall construct at T2 and suitable for subsequent analyses.

Conclusion. This section delved into the dimensionality and construct validity of both general and school grit across two time points, revealing nuanced insights into their structure

and stability. The findings suggest that while grit can be modeled as a higher-order construct, its robustness and reliability vary by context and timing. General grit showed some instability, particularly at T2, with a weakened relationship between its subscales. In contrast, school grit demonstrated a robust hierarchical factor structure at both time points, even when individual subscales exhibited limitations. Moreover, overall school grit, school grit-PE, and school grit-CI had markedly higher test-retest correlations ($r = .657$, $r = .665$, and $r = .548$, respectively) than the general grit subscales ($r = .373$ and $r = .383$, respectively). This implies that the school grit measure is not only more robust in its factor structure but also more stable over time. One plausible explanation for school grit's higher test-retest reliability is that students found the school-related items relatable and contextually relevant, whereas they may have struggled to assess their commitment to goals or interests outside of the school context.

The findings underscore the potential value of context-specific measures, like school grit, which appear to resonate more strongly with students and offer a more reliable assessment of the construct in the school environment. Moving forward, it will be essential to account for these variations in structure and stability when testing grit's predictive power in different settings. Ongoing refinement of grit measures may be needed to ensure they remain contextually relevant and psychometrically sound across diverse populations and time points.

6.6 Handling of Student Grades Data and Calculation of the GPA

The school year in Bremen is divided into two terms: the 'first half-year' (roughly August to January) and the 'second half-year' (roughly February to July). The grit interventions were conducted at the end of May 2019, and school-supplied end-of-term marks were collected in January 2019 (T1, pre-intervention), and at four additional time points: July 2019, January 2020, July 2020, and January 2021. By the end of the data collection phase, Grade 7 students were halfway through Grade 9, and Grade 8 students were halfway through Grade 10¹¹². School grades in key subjects—German, English, Social Sciences, Mathematics, and Natural Sciences—were used in the current study to assess students' academic progress.

Comprehensive secondary schools cater to students of varying abilities and offer three course types (or levels): undifferentiated courses (U), which are taught to all students within a grade level, regardless of ability, ensuring uniform instruction and assessment; basic courses (B), which provide foundational support for below-average performers; and advanced courses (A), which feature challenging content and are geared toward higher ability students. Table

¹¹² A student's grade *level* will always be referred to as Grade 7, Grade 8 etc. (using capital G, followed by a numeral), whereas the scores or assessments given to students for their academic performance will be referred to as (school) grades (plural form, not capitalized) or (school) marks.

6.4 (p. 138) shows the school subjects offered across different grade levels and time points.

Given the complexity of the grading system across different course types and grade levels, calculating end-of-term Grade Point Averages (GPAs) using raw grades would not allow for meaningful comparisons. Marks in basic-level courses are not directly comparable to those in advanced-level courses, and marks in different grade levels (e.g., Grade 7 vs. Grade 8) reflect different grading standards and curricula. Moreover, many students transition between course levels—such as from basic to advanced or vice versa—further complicating the interpretation of raw grades. Typically, students moving up (B to A) experience a grade drop due to higher standards in the advanced course. While this drop might numerically suggest a decline in performance from one term to the next, it is actually a higher-order improvement, more meaningful than achieving a better grade within the same course level. Conversely, moving down (A to B) often results in better raw grades, but this shift is in reality a higher-order decline, as it reduces students' eligibility for the Abitur, which requires a certain number of A-level courses.

To account for the differences in grading standards between course levels, I calculated two indicators. The first, a sample-wide 'change factor', quantified the average grade difference for students moving between course levels. For example, on average, a grade of 2 in a basic course (equivalent to a 'B' in the U.S.) corresponded roughly to a grade of 3 in an advanced course (equivalent to a 'C' in the U.S.). For the second indicator, I examined school subjects that began as U courses and later split into B and A levels (e.g., Natural Sciences from Grade 7 to Grade 8) and subjects that were taught as U courses after being previously taught as B and A levels (e.g., Biology (U) in Grade 9, following Natural Sciences (B/A) in Grade 8). The 'ability differential' measured the average performance gap *in undifferentiated courses* between students who subsequently (or previously) took the B version of the course and those who took the A version. This gap was nearly identical to the 'change factor', indicating that the average difference in ability between basic-level and advanced-level students within the same (undifferentiated) course also approximates one full grade.

Using the value suggested by these two indicators, grades from B-level courses were adjusted to match those from A-level courses—considered the desired 'standard' and attended by over two-thirds of the students in this sample—thereby enhancing comparability across course types. This adjustment had the added benefit of mitigating the apparent grade decline for upwardly mobile students and the apparent grade improvement for downwardly mobile students by normalizing basic course grades to the advanced-level standard while keeping advanced course grades unchanged. Because undifferentiated courses apply uniform

Table 6.4*Overview of Subjects by Grade Level, Time Point, and Course Type*

Grade Level (T1/T2)	Time 1 (T1) January 2019	Time 2 (T2) July 2019	Time 3 (T3) January 2020	Time 4 (T4) July 2020	Time 5 (T5) January 2021	Grade Level (T5)
Grade 7	Ger (U)	Ger (U)	Ger (B/A)	Ger (B/A)	Ger (B/A)	Grade 9
	Eng (B/A)	Eng (B/A)	Eng (B/A)	Eng (B/A)	Eng (B/A)	
	SocSci (U)	SocSci (U)	SocSci (U)	SocSci (U)	SocSci (U)	
	Math (B/A)	Math (B/A)	Math (B/A)	Math (B/A)	Math (B/A)	
	NatSci (U)	NatSci (U)	NatSci (B/A)	NatSci (B/A)	Phys (B/A)^a Bio (U)^a Chem (U)^a	
Grade 8	Ger (B/A)	Ger (B/A)	Ger (B/A)	Ger (B/A)	Ger (B/A)	Grade 10
	Eng (B/A)	Eng (B/A)	Eng (B/A)	Eng (B/A)	Eng (B/A)	
	SocSci (U)	SocSci (U)	SocSci (U)	SocSci (U)	SocSci (U)	
	Math (B/A)	Math (B/A)	Math (B/A)	Math (B/A)	Math (B/A)	
	NatSci (B/A)	NatSci (B/A)	Phys (B/A)^a Bio (U)^a Chem (U)^a	Phys (B/A)^a Bio (U)^a Chem (U)^a	Phys (B/A)^a Bio (U)^a Chem (U)^a	

Note. Ger = German, Eng = English, SocSci = Social Sciences, Math = Mathematics, NatSci = Natural Sciences, Phys = Physics, Bio = Biology, Chem = Chemistry, U = Undifferentiated, B = Basic, A = Advanced; New subjects or changes in course type are **emphasized**.

^a The former NatSci subject splits into Physics, Biology, and Chemistry.

requirements and grading criteria to students of all abilities, their grades inherently account for the ‘ability differential’ between below-average and above-average students, rendering further adjustments unnecessary. Subsequently, all grades were z-standardized within each grade level (Grade 7 and Grade 8) and course type (undifferentiated and unified basic /advanced). This standardization enables meaningful comparisons of students’ performance relative to their peers within the same context (i.e., same course type and grade level).

Given that in the German grading system a 1(+) is the best grade and 5/6 are failing grades, a lower GPA would counterintuitively signify better performance. To address this, the sign of the z-scores was reversed after standardization, ensuring that higher GPA values reflect better academic outcomes. Following this adjustment, end-of-term GPAs were calculated by averaging all normalized (and later z-standardized) grades for each term. This composite measure reflects students’ academic performance, independent of their unique mix of course levels in any given term or potential transitions between course levels across terms. Thus, this approach provides a more equitable basis for comparison, thereby enabling a more accurate assessment of the grit interventions’ impact on students’ academic trajectories.

7 Quantitative Strand: A Cross-Sectional Examination of Grit, Related Constructs, and School Performance

The primary objective of this chapter is to advance existing research on the relationships between grit, several theoretically and empirically related constructs, and school performance. This is accomplished by exploring the connections between domain-general grit and school-specific grit (both as higher-order latent variables and as separate consistency and perseverance components) and a set of associated constructs, namely conscientiousness, school-specific self-control and self-efficacy, implicit theories of intelligence (mindset), school belonging, and school engagement. The constructs assessed are based on theories of personality, self-regulation, social cognition and social learning, motivation and engagement, and social identity and belongingness. This theoretically eclectic approach builds on prior research demonstrating strong correlations between many of these constructs and grit, further reinforced by calls to clarify the nature of their relationship (e.g., Duckworth et al., 2007; Duckworth & Gross, 2014; Rimfeld et al., 2016).

The following research questions (RQs) are addressed in the present chapter:

- » RQ 1: How do domain-general and school-specific grit relate to other constructs in their nomological network?

Given its exploratory nature, this inquiry is guided by assumptions based on previous grit research but does not have a clear-cut hypothesis. Grit is expected to show positive associations with conscientiousness, school belonging, school self-control, school self-efficacy, and school engagement while being negatively associated with mindset (where high scores indicate a fixed mindset). Based on results from several studies (e.g., Credé et al., 2017; Schmidt et al., 2019), grit is assumed to correlate most strongly with conscientiousness and school self-control.

- » RQ 2a: How strongly do students' grit and the other variables relate to students' GPA?

Do the grit variables explain unique variance in GPA over and above other constructs?

The working hypothesis for RQ 2a (WH 2a) proposes that grit—especially its perseverance of effort facet—will have a positive and significant relationship with students' GPA, consistent with findings from several meta-analyses and systematic reviews (e.g., Credé et al., 2017; Lam & Zhou, 2019; Saleh et al., 2019). Based on the limited research available on school-specific grit (e.g., Cormier et al., 2019; Schmidt et al., 2019), school grit is anticipated to have a stronger association with academic performance than domain-general grit. Furthermore, it is expected that grit, particularly school grit, will explain additional

variance in school grades beyond demographic variables¹¹³, conscientiousness, and other related constructs, despite mixed evidence supporting this hypothesis.

- » RQ 2b: What is the relative importance of the grit variables for GPA when including all other predictors simultaneously in the analytic model?

The only study I am aware of examining grit's *relative importance* for school achievement alongside theoretically and empirically related predictors (Steinmayr et al., 2018) found that grit did not fare well compared to variables like academic self-concept, behavioral engagement, or expectancies of success. Since the current study includes (mostly) different grit correlates, formulating a hypothesis is not feasible or meaningful in this context.

- » RQ 2c: Is the impact of grit on GPA moderated by students' socio-educational advantage (SEA), gender, cohort, or academic ability?

WH 2c posits that grit will have a stronger association with GPA for students lower in SEA and academic ability (based on findings by e.g., A. Liu, 2019). In contrast, cohort and gender¹¹⁴ are less likely to moderate the grit-achievement link significantly.

- » RQ 2d: Is the impact of grit on GPA mediated by students' school engagement?

Based on the hypothesized model of grit and its relation to performance outlined in the theoretical framework (section 3.3), WH 2d proposes that the impact of grit on GPA will be at least partially mediated by school engagement.

7.1 Research Question 1

7.1.1 Method Overview (RQ 1)

In this part of the cross-sectional study (T1, pre-intervention), the relationships between domain-general grit, school-specific grit, and their correlates are analyzed. The analysis is conducted in three steps: first, the bivariate correlations among these variables are interpreted; second, hierarchical multiple regressions are performed to identify the strongest predictors¹¹⁵ of grit. Finally, the bidirectional relationships between these constructs are evaluated, with a focus on the asymmetry in their predictive power. Detailed information on measures, participants, and procedures, applicable to all four RQs in this chapter, is provided

¹¹³ See Usher et al. (2019) for a study where grit did not predict academic achievement among elementary and middle school students in the U.S. when gender, year level, and socioeconomic status were added as covariates.

¹¹⁴ A recent meta-analysis by Lam and Zhou (2022) concluded that gender does not moderate the grit-achievement link. In an earlier meta-analysis (2019), the same authors found that grade level does have a moderating effect, with grit having a stronger impact on academic achievement in primary and secondary education than in higher education. However, in the current study, no such difference is anticipated between students in Grade 7 and Grade 8, as the age and developmental variations are likely not substantial enough.

¹¹⁵ The terms 'predict' / 'predictor' are customary in regression analysis even in the context of cross-sectional studies. In using them here, and unless otherwise stated, I distance myself from any potential implications of causation or temporal prediction. Whenever feasible, I also use alternative phrasing.

in sections 5.4, 5.5, and 5.6, respectively.

7.1.2 Statistical Analyses and Results (RQ 1)

The Kolmogorov-Smirnov test indicated significant deviations from normality in six of the 12 variables ($p < .05$), leading to the use of bootstrapping techniques in subsequent analyses to ensure robust estimates. Bootstrapping, a resampling method that generates multiple samples from the original data, facilitates the estimation of standard errors, confidence intervals, and p -values without assuming normality. Additionally, it is well-suited for small sample sizes and complex data structures, enhancing the reliability of the findings (Davison & Hinkley, 1997).

To assess the strength of the relationships between the grit variables and their nomological neighbors, bivariate correlations were analyzed, with missing data handled through listwise exclusion. The dataset included 203 participants, with variables mean-centered or dimension-reduced using EFA or, for grit, CFA. Descriptive statistics and two-tailed bootstrapped Pearson correlations are presented in Table 7.1 (p. 144).

The correlation matrix revealed two significant correlations at the .05 level (indicated with one *) and several highly significant correlations at the .01 level (**), ranging from .190 to .922. General grit and school grit were, as expected, very strongly related to their respective perseverance and consistency components ($r > .80^{**}$)¹¹⁶, underlining the internal consistency of the grit constructs. Similarly, overall general grit and overall school grit were also strongly correlated ($r = .740^{**}$), which was foreseeable given that school grit is measured using a variation of the Grit-S instrument that includes domain-specific wording. Interestingly, the two facets of school grit were more closely correlated than those of general grit ($r = .686^{**}$ vs. $r = .437^{**}$), suggesting that perseverance and consistency align more in the school context.

Conscientiousness. As expected based on existing grit literature, conscientiousness was highly correlated to general grit-PE ($r = .614^{**}$), overall general grit ($r = .612^{**}$), overall

¹¹⁶ Given the wide range of significant correlations in my study (.169 to .922) and the fact that 49% of the bivariate correlations between my variables (*excluding* the expectedly high ones between general grit and school grit and their respective components) are *above* .40, I will use ‘very strongly’ related (or very highly correlated) for r sizes above .80, ‘strongly’ related (or highly correlated) for r sizes between .60 and .79, ‘moderately’ related for r sizes between .30 and .59, ‘weakly’ related for r sizes between .10 and .29 and ‘very weakly / negligibly’ related for r sizes below .10. I am well aware that this terminology is not in line with Cohen’s (1988) benchmarks for small, medium, and large effects (0.10, 0.30, 0.50), nor with the guidelines proposed by Gignac and Szodorai (2016) for individual differences researchers (0.10, 0.20, 0.30) or even the recommendations offered by Funder and Ozer (2019; 0.5 very small, .10 small, .20 medium, .30 large, $\geq .40$ very large). However, they more closely reflect the size and incidence of the correlation coefficients in my own analysis. This line of reasoning follows Schäfer and Schwartz (2019), who are among numerous researchers to critique the universal application of terms like small, medium, or large for effect sizes (including Pearson’s r), arguing that these benchmarks are not universally applicable across all sub-disciplines of psychology and across different study designs, and the interpretation of an effect’s magnitude is highly dependent on the research context and the particular research question being addressed.

school grit ($r = .605^{**}$), and school grit-PE ($r = .604^{**}$). Furthermore, it was moderately related to school grit-CI and general grit-CI ($r = .506^{**}$ and $r = .417^{**}$, respectively). These relationships are *not* as strong as those found by Credé et al. (2017) in a large-scale meta-analysis (reliability-corrected meta-analytic correlations of $\rho = .84$ for overall grit, $\rho = .83$ for perseverance, $\rho = .61$ for consistency), which led them to conclude that grit may be redundant. Indeed, in the current sample, grit and conscientiousness seem to be sufficiently distinct, which is further reinforced by the intriguing finding described in section 7.2.2 (RQ 2a) that school grit is a significant positive predictor of grades while conscientiousness is a significant *negative* predictor of grades.

School Self-Control. Self-control, regarded as a facet of conscientiousness, has been shown to have a strong relationship with grit, particularly its perseverance component. Correlations reported in the literature range from .48 to .81, with Gonzalez et al. (2020, $r = .728$) and Credé et al. (2017, meta-analytic correlation of $\rho = .72$) suggesting significant construct overlap between grit and self-control. Most studies examining grit and self-control have utilized the Brief Self-Control Scale (BSCS) to assess domain-general self-control. Notable exceptions are Meindl et al. (2019) who combined the BSCS with a school self-control scale (which correlated highly with grit $r = .63$) and Yeager et al. (2014), who employed the English version of the academic self-control scale used in the current study, finding a correlation of $r = .58$ between grit¹¹⁷ and academic self-control. Unsurprisingly, in the current sample, school self-control was most closely associated with school grit-PE ($r = .660^{**}$), followed by overall school grit and ($r = .633^{**}$) and general grit-PE ($r = .623^{**}$), confirming that (school) grit / perseverance and school self-control go hand in hand. Moderate correlations with school grit-CI ($r = .499^{**}$) and weaker associations with general grit-CI ($r = .264^{**}$) align with findings that perseverance shares more variance with conscientiousness and its facets than the consistency of interests subscale.

School Self-Efficacy. Outside the conscientiousness family, grit shows moderate to high correlations with (generalized) self-efficacy, which refers to an enduring sense of confidence in one's ability to effectively handle a wide range of demanding or novel situations. In their meta-analysis, Credé et al. (2017) found a correlation of $\rho = .43$ between the two constructs. Academic self-efficacy, the belief in one's ability to succeed in *academic* tasks, has also been strongly linked to grit ($.34 \leq r \leq .66$) in prior studies (e.g., Dixon et al.,

¹¹⁷ The authors used an abbreviated version of the Grit-S scale with three items from its perseverance subscale and one item from its consistency subscale. In this sense, their instrument may be considered a proxy for the perseverance facet of grit.

2016; Faust & Rosendale, 2023; Meindl et al., 2019; Oriol et al., 2017; Usher et al., 2019). In the current study, school self-efficacy was most strongly associated with overall school grit ($r = .616^{**}$), followed by school grit-PE ($r = .602^{**}$) and school self-control ($r = .581^{**}$). Notably, school self-efficacy is one of the two variables that correlated significantly with *all* other variables included in the analysis, except mindset. It appears that believing in one's ability to cope with trials or setbacks may indeed be necessary for (school) grit, school self-control, school engagement, and school belonging.

Mindset. In addition to self-efficacy, growth mindset and social belonging—two other key concepts in the *academic mindsets* literature¹¹⁸—were shown in prior studies to correlate with grit and to influence positively academic achievement and student well-being (e.g., Bowman et al., 2015; SRI International, 2018; Walton & Wilson, 2018). Contrary to expectations, the mindset variable (where high scores indicate a fixed mindset) did not significantly correlate with grit or other constructs analyzed. Most correlations, except with general grit-CI ($r = -.110$), were weakly positive, countering findings that a growth mindset typically aligns with grit and related traits (e.g., Meindl et al., 2019). These results, however, are consistent with Zamarro et al. (2016), who found no significant link between growth mindset and grit, conscientiousness, or self-discipline in a U.S. sample. Rammstedt et al. (2022) suggested, in a German context, that the term ‘intelligence’—referenced in all three scale items—might be interpreted differently in German compared to English, potentially limiting the response process validity of the measure.

School Belonging. Belonging, on the other hand, correlates weakly but significantly (at the .01 level) with school self-efficacy ($r = .280^{**}$), overall school grit ($r = .201^{**}$), school perseverance ($r = .198^{**}$), and school engagement ($r = .190^{**}$). This suggests that students who feel a sense of belonging in their school community are more likely to exhibit higher school self-efficacy, grit, and engagement. These findings align with Bowman et al. (2015), who noted—albeit in a university context—that grittier students showed a greater sense of belonging and participated more in co-curricular activities, highlighting that “grit may beget success through pathways beyond simply what happens in the classroom” (p. 644). The correlation between belonging and school grit, but not general grit, likely reflects their shared focus on the school environment; a strong sense of belonging boosts motivation and persistence in school-specific tasks but may not extend to other contexts.

¹¹⁸ As a reminder, the academic mindsets literature includes a) beliefs about competence (e.g., self-efficacy, growth mindset), b) values and goals, and c) beliefs about social connectedness and belonging (SRI International, 2018).

Table 7.1

Variable	<i>n</i>	<i>M^a</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12
1. Grit (gen.)	205	.00	0.63	—											
2. Perseverance (gen.)	205	.00	1.08	.857**	—										
3. Consistency (gen.)	205	.00	1.02	.838**	.437**	—									
4. Grit (school)	205	.00	0.78	.740**	.704**	.546**	—								
5. Perseverance (school)	205	.00	1.38	.692**	.749**	.414**	.922**	—							
6. Consistency (school)	205	.00	1.34	.666**	.538**	.593**	.914**	.686**	—						
7. Conscientiousness	205	.00	0.87	.612**	.614**	.417**	.605**	.604**	.506**	—					
8. School belonging	206	.00	0.81	.078	.095	.035	.201**	.198**	.169*	.170*	—				
9. School self-control	205	.00	1.13	.530**	.623**	.264**	.633**	.660**	.499**	.491**	.131	—			
10. School self-efficacy	206	.00	1.12	.503**	.562**	.283**	.616**	.602**	.527**	.379**	.280**	.581**	—		
11. School engagement	205	.00	0.42	.491**	.450**	.381**	.614**	.565**	.562**	.438**	.190**	.440**	.382**	—	
12. Mindset	204	.00	1.05	.010	.120	-.110	.063	.103	.011	.043	.016	.048	.054	.023	—

Note. Bootstrapping was used for correlation coefficients to ensure robustness. Bootstrap results are based on 1000 bootstrap samples.

^a All means are zero due to mean centering (for two-item scales) or dimension reduction via EFA / CFA (for scales with ≥ 3 items).

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

School Engagement. Finally, the school engagement measure, which assesses academic behaviors such as doing homework, paying attention in class, participating actively in class, and working hard in school, is significantly correlated at the .01 level with all other psychological variables, apart from mindset. Auspiciously, it is most strongly related to overall school grit ($r = .614^{**}$), followed by its separate components ($r = .565^{**}$ for school grit-PE and $r = .562^{**}$ for school grit-CI). Assuming the direction of the causal relationship is primarily from psychological resources to behaviors (though sustained behavioral changes may drive personality change over time), the current data shows that *school grit*, more than any other resource discussed thus far, is likely to promote school engagement, which in turn could lead to improved academic outcomes.

The strength of the relationships described above highlights potential pathways for interventions to enhance grit in the school context. Targeting school self-control, school self-efficacy, conscientiousness, and, to a lesser extent, school belonging, may increase school grit, which is closely linked to greater school engagement.

However, to examine the impact of these explanatory variables (i.e., predictors or IVs) on grit (i.e., outcome or DV), two sets of hierarchical multiple regression analyses were conducted, as detailed below. Estimating the distinct effect of these variables on grit requires controlling for as many confounding factors as possible. Hierarchical multiple regression (HMR, also known as sequential multiple regression) provides a distinct advantage over standard multiple regression by allowing IVs to be entered into the regression equation in a deliberate sequence. This approach enables the control of covariate effects on the results and helps determine how much additional variance in the DV is explained by the inclusion of specific predictors.

HMR with Overall General Grit as a DV. In the first hierarchical regression analysis predicting general grit (T1, pre-intervention), Model 1 included demographic variables (cohort¹¹⁹, gender, SEA), explaining 7.9% of the variance in general grit ($R^2 = .079$, $F(3, 199) = 5.684$, $p < .001$). Gender ($\beta = .160$, $p = .020$) and SEA ($\beta = .221$, $p = .001$) were significant predictors, indicating that female students and those with higher socio-educational advantage had higher general grit scores.

Model 2 added psychological variables (school grit residual, conscientiousness, school belonging, school self-control, school self-efficacy, school engagement), significantly improving the explained variance in general grit to 62.2% ($R^2 = .622$, $F(7, 192) = 31.630$, $p <$

¹¹⁹ See section 7.6 for a discussion of cohort vs. class as a control variable.

.001). The ANOVA results confirmed the overall significance of both models.

Multicollinearity was not detected (all VIF values < 2, all tolerance values > .5), and the bootstrap analysis confirmed the robustness of the regression coefficients. Gender remained a significant predictor ($\beta = .118, p = .011$), but SEA did not, suggesting that the psychological variables account for much of the variance in general grit that was initially attributed to SEA. Key predictors included conscientiousness ($\beta = .371$), school grit residual ($\beta = -.352$), self-efficacy ($\beta = .282$), engagement ($\beta = .250$), and school self-control ($\beta = .211$) (all $p < .001$).

The significant positive correlation between general grit and school grit ($r = .740^{**}$) from the previous section indicates a strong linear relationship when considered *in isolation*. However, the regression analysis shows a negative coefficient for the school grit residual, suggesting that its unique contribution to general grit is negative when other variables are controlled. This may reflect a compensatory effect, where unique aspects of school grit *detract* from general grit, or context-specific differences in grit expression. Analyzing school perseverance and consistency residuals as separate predictors could clarify which component impacts general grit negatively. Overall, the significant predictors in Model 2 suggest that conscientiousness, self-efficacy, and self-control may play critical roles in explaining general grit (see Table 7.2, below).

Re-running the regression with school grit components (perseverance and consistency) as residuals instead of the overall school grit residual revealed notable changes. The final model ($R^2 = .572, F(8, 191) = 23.201, p < .001$) explained 57.2% of the variance in general grit, less than the 62.2% explained by the model with the aggregated school grit residual,

Table 7.2

Hierarchical Multiple Regression Predicting General Grit at Time 1

	<i>b</i>	<i>SE b</i>	β	<i>t</i>	<i>p</i>	95% CI for <i>b</i>		<i>R</i>	<i>R</i> ²	ΔR^2	ΔF	<i>p</i> (ΔF)
						<i>LL</i>	<i>UL</i>					
Model 1								.281	.079		5.684	<.001
(Constant)	-.672	.662		-1.015	.312	-1.977	.634					
Cohort	.076	.087	.060	.875	.383	-.095	.248					
Gender	.203	.086	.160	2.354	.020	.033	.373					
SES Index	.177	.055	.221	3.242	.001	.069	.285					
Model 2								.789	.622	.543	39.455	<.001
(Constant)	.240	.448		.536	.592	-.644	1.124					
Cohort	-.041	.059	-.032	-.693	.489	-.157	.075					
Gender	.150	.058	.118	2.573	.011	.035	.264					
SES Index	.020	.038	.025	.516	.606	-.056	.096					
Grit (school) residual	-.422	.061	-.352	-6.971	<.001	-.541	-.303					
Conscientiousness	.270	.039	.371	6.896	<.001	.193	.348					
School belonging	-.044	.037	-.057	-1.195	.234	-.117	.029					
School self-control	.118	.034	.211	3.432	<.001	.050	.185					
School self-efficacy	.160	.034	.282	4.715	<.001	.093	.227					
Mindset	-.012	.027	-.020	-.445	.657	-.065	.041					
School engagement	.377	.082	.250	4.607	<.001	.215	.538					

suggesting that the latent higher-order school grit variable captures the variability in the data more effectively than its disaggregated components. The aggregated school grit residual ($\beta = -.352, p < .001$) had been a stronger predictor than its components, whose combined beta coefficients ($-.151$ and $-.154$) and significance levels ($.007$ and $.011$) were lower, supporting the idea that the aggregated measure captures the essence of school grit better than its components. *Both* school perseverance and school consistency residuals were negatively associated with general grit, providing a nuanced—albeit perplexing—understanding of how specific and general aspects of grit interact. Despite a slight reduction in explained variance, the model remained robust, with conscientiousness emerging once again as the strongest covariate of general grit ($\beta = .390$).

HMR with Overall School Grit as a DV. In the hierarchical regression analysis predicting *school grit* (T1, pre-intervention), Model 1 with demographic variables (cohort, gender, SEA) explained 8.4% of the variance in the DV ($R^2 = .084, F(3, 199) = 6.070, p < .001$), slightly more than the model for general grit. SEA was a stronger predictor for school grit than it had been for general grit ($\beta = .251, p < .001$), while gender showed a weaker association ($\beta = .142, p = .038$). Model 2, which added the same set of psychological predictors and the general grit residual, explained 67.8% of the variance in school grit ($R^2 = .678, F(7, 192) = 40.400, p < .001$), a 5.6% improvement over the equivalent analysis for general grit. As with general grit, SEA was no longer a significant predictor in the final model, as its contribution to school grit was suppressed by the added variables. Significant predictors in Model 2 were conscientiousness ($\beta = .299$), school self-efficacy ($\beta = .280$), school engagement ($\beta = .270$), school self-control ($\beta = .227$) (all $p < .001$), and the general grit residual ($\beta = -.135, p = .002$). The latter, though also negatively associated with school grit, was a weaker predictor than school grit had been for general grit. This suggests that grit displayed in specific contexts, like school, has a stronger negative impact on the general trait than the reverse. Students with high school grit may have limited capacity to exhibit grit in other areas, while those pursuing personally relevant goals outside of school might experience a smaller negative impact on their school grit. Further analysis of the general grit-PE and general grit-CI residuals may clarify whether one or both components contribute to this negative relationship.

All in all, the significant predictors in Model 2 indicate that conscientiousness (to a lesser extent than for general grit), school self-efficacy, and school self-control are also important for school grit. As expected, school engagement is more strongly linked to school

grit than general grit, with a one-unit increase in engagement raising school grit by 0.505 units (see Table 7.3, below). This suggests school grit plays a greater role in behavioral school engagement and may also emerge as a stronger predictor of GPA in subsequent analyses.

Using the separate general grit components as residuals instead of the overall general grit residual revealed several findings. Conscientiousness, school self-efficacy, school engagement, and school self-control remained significant predictors with similar effect magnitudes. The model with the separate components ($R^2 = .686$, $F(8, 191) = 37.963$, $p < .001$) explained slightly more variance in school grit (68.6%) than the model with the overall residual (67.8%). However, the stronger F -value for the overall residual model ($F(7, 192) = 40.400$) suggests better overall fit, highlighting a trade-off between model complexity and explanatory power.

A closer look at the coefficients revealed the reason the separate components are better at explaining variance in school grit than the overall general grit residual. The general consistency component was not significantly associated with school grit ($\beta = .003$, $p = .953$), while the general perseverance component had a stronger negative impact ($\beta = -.168$, $p < .001$) than the overall residual in the previous analysis. This suggests that perseverance in non-school-related goals detracts from school grit, while consistency does not. Thus, while for school grit the aggregated measure was superior in its explanatory power, for general grit the matters are not nearly as straightforward, and separating the components provided unique information about the interplay between different facets of general and school-specific grit.

Table 7.3

Hierarchical Multiple Regression Predicting School Grit at Time 1

	<i>b</i>	<i>SE b</i>	β	<i>t</i>	<i>p</i>	95% CI for <i>b</i>		<i>R</i>	<i>R</i> ²	ΔR^2	ΔF	<i>p</i> (ΔF)
						<i>LL</i>	<i>UL</i>					
Model 1								.290	.084		6.070	<.001
(Constant)	-.050	.819		-.061	.952	-1.665	1.566					
Cohort	-.007	.108	-.004	-.062	.950	-.219	.206					
Gender	.223	.107	.142	2.093	.038	.013	.433					
SES Index	.250	.068	.251	3.698	<.001	.117	.383					
Model 2								.823	.678	.594	50.576	<.001
(Constant)	.540	.512		1.054	.293	-.470	1.551					
Cohort	-.081	.067	-.051	-1.204	.230	-.214	.052					
Gender	.165	.067	.105	2.468	.014	.033	.296					
SES Index	.013	.044	.013	.296	.767	-.074	.100					
Grit (general) residual	-.248	.079	-.135	-3.123	.002	-.405	-.091					
Conscientiousness	.270	.046	.299	5.848	<.001	.179	.362					
School belonging	-.019	.042	-.019	-.438	.662	-.102	.065					
School self-control	.157	.039	.227	4.053	<.001	.081	.234					
School self-efficacy	.197	.038	.280	5.116	<.001	.121	.273					
Mindset	.002	.031	.002	.056	.956	-.059	.063					
School engagement	.505	.092	.270	5.507	<.001	.324	.686					

Exploring Bidirectional Relationships between Grit and Its Correlates. Although significant relationships exist between conscientiousness, school self-efficacy, school self-control, school engagement, and general or school grit, cross-sectional regression analyses cannot establish causal links between these variables. Previous research suggests that these relationships are bidirectional—for example, while self-efficacy may significantly predict grit, grit can also meaningfully influence self-efficacy. This reciprocal dynamic makes it challenging to determine whether enhancing one attribute will lead to improvements in the other or if both need to be addressed simultaneously. Such ambiguity complicates intervention strategies, potentially leaving educators uncertain about which construct to prioritize to achieve optimal educational outcomes.

To understand better the associative strength and potential directional influences among these constructs, I conducted a series of hierarchical multiple regression analyses similar to those described earlier. The key difference is that general and school grit are now treated as predictors (alongside the other psychological variables), while conscientiousness, school self-efficacy, school self-control, and school engagement serve as the dependent variables, one at a time. By comparing the R^2 values of these models with their earlier counterparts, we can assess whether grit explains more variance in, for instance, self-efficacy than self-efficacy explains in grit, while holding all other factors constant. Additionally, examining the standardized beta coefficients offers insight into the strength and directionality of these relationships, with demographic and psychological variables controlled in the same manner as before.

HMRs with General and School Grit as Predictors. Models with general and school grit as predictors generally exhibited lower R^2 values than those where general and school grit were the DVs, indicating that conscientiousness, school self-efficacy, school self-control, and school engagement collectively explain more variance in grit than these variables, including grit, explain in conscientiousness, school self-efficacy, school self-control, and school engagement, respectively. However, beta coefficients for general and school grit as predictors were higher than those for the same variables predicting grit. For example, general grit significantly predicted conscientiousness ($\beta = .536$), a stronger association than conscientiousness predicting general grit ($\beta = .371$). Similarly, school grit was a stronger predictor of conscientiousness ($\beta = .506$) than the reverse ($\beta = .299$). This suggests that while conscientiousness is an important predictor of grit, its influence is comparatively weaker than the influence of grit on conscientiousness. This pattern extends to school self-efficacy, school self-control, and school engagement, with grit—particularly

school grit—explaining significantly more variance in these variables than they previously explained in grit. In the latest regressions with grit as an IV, at least one aggregate grit measure and/or grit component were by far the strongest predictors in all models.

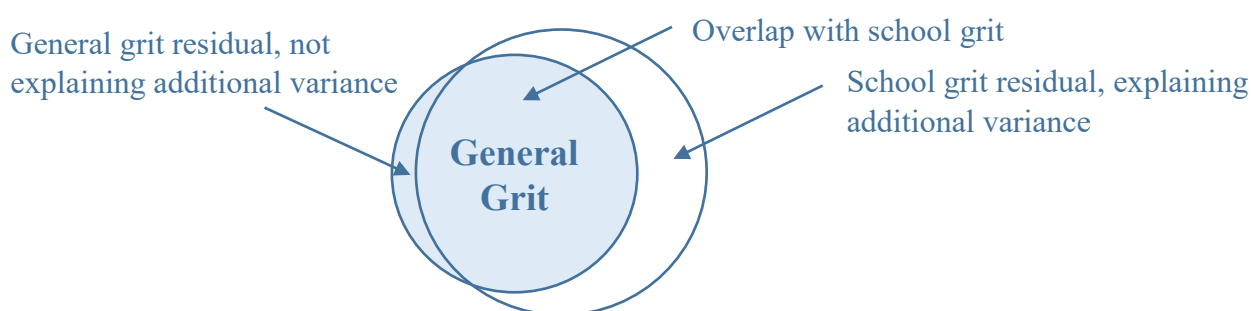
The analysis also revealed that school grit residuals significantly predicted school self-efficacy, conscientiousness, school self-control, and school engagement, capturing *additional* context-specific variance beyond general grit. Conversely, general grit residuals were *not* significant predictors when school grit was included. Taken together, these results hint at the possibility that the conceptual overlap between school grit and general grit is asymmetric, with school grit capturing most of the shared explanatory power between the two constructs in relation to these school-specific outcomes. Fig. 7.1 (below) shows this assumed relationship.

A third finding worth mentioning is that models with separate general grit components explained slightly more variance in the DVs than those with the aggregated general grit variable, with perseverance being more strongly associated with conscientiousness, school self-efficacy, and school self-control¹²⁰ than general consistency. This pattern was less evident for school grit, where the higher-order variable performed similarly to its components. Surprisingly, for school engagement, which was only significantly linked to grit (like conscientiousness), general and school consistency emerged as *stronger* predictors than perseverance. Thus, while perseverance appears crucial for self-efficacy, self-control, and conscientiousness, having sustained goals and interests over a long period of time seems more relevant for school engagement.

These results underscore grit, both general and school-specific, as a distinct and influential predictor, particularly for school engagement. Its higher beta coefficients indicate a substantial effect, suggesting that grit may serve as a foundational trait shaping other

Figure 7.1

Presumed Conceptual Overlap between General Grit and School Grit



¹²⁰ General consistency was not associated at all with school self-control ($\beta = -.008, p = .902$).

psychological variables. Individuals with higher grit levels are more likely to exhibit traits like conscientiousness and school self-control, which, while also predictive of grit, exert comparatively smaller influences. This reflects a bidirectional but asymmetrical relationship, with grit playing the more dominant role.

The lower R^2 values in models with grit as a predictor imply that factors influencing conscientiousness, school self-efficacy, school self-control, and school engagement are influenced by additional unmeasured factors. Conversely, higher R^2 values when grit is the outcome suggest its variance is well explained by a combination of factors, reflecting its multifaceted nature. The presence of multiple significant predictors for grit highlights the need to consider a broader range of determinants when aiming to enhance grit through interventions. The hope is that enhancing grit at school could also lead to improvements in related psychological factors, providing a more holistic approach to personal development.

7.1.3 Summary of Key Findings for RQ 1

The first research question explored the relationships between domain-general and school-specific grit and various psychological constructs in their nomological network, using both bivariate correlations and hierarchical multiple regressions. Bivariate correlations show that general grit and school grit are strongly related to each other and to conscientiousness, self-efficacy, self-control, and engagement. These relationships were particularly pronounced for school grit, underscoring its importance in the school context. Unexpectedly, higher grit was associated with a slightly more fixed mindset, though this relationship was not statistically significant. Belonging was weakly yet significantly and positively associated with both school grit and engagement. These findings suggest that interventions targeting conscientiousness, self-efficacy, self-control, and school belonging could boost (school) grit, which, through its strong link to school engagement, may enhance academic outcomes.

Hierarchical regressions identified conscientiousness, self-efficacy, self-control, school engagement, and gender as significant predictors of both grit constructs. Interestingly, general and school grit negatively influenced each other's residuals, possibly due to limits in grit's manifestation across domains. In the reverse analysis, both types of grit—especially their perseverance facets—strongly predicted conscientiousness, self-efficacy, self-control, and engagement, with grit emerging as a more robust predictor of these traits than vice versa. School grit residuals uniquely predicted other school-related measures, emphasizing the importance of context-specific grit in influencing traits and behaviors in the school setting.

Altogether, the findings for RQ 1 underline grit's pivotal role in its nomological network. The nuanced interactions between general and school grit suggest that *context*

matters, with school grit emerging as more important in the school setting. While grit strongly predicts certain attributes and behaviors, it is itself influenced by multiple factors, particularly conscientiousness, school self-efficacy, and school self-control. Therefore, when designing interventions to improve educational outcomes, it is important to adopt a comprehensive approach that addresses both the specific role of grit and the broader influence of other key variables. The distinct role of (school) grit in predicting school engagement, in particular, suggests that interventions targeting grit could be especially effective in fostering student engagement in educational settings.

7.2 Research Question 2a

7.2.1 Method Overview (RQ 2a)

The next section examines how the two types of grit and other variables in their nomological network, all measured at Time 1 (pre-intervention), correlate with students' grades, expressed as a half-year GPA. Additionally, hierarchical multiple regression (HMR) analyses are used, with grit added in the final step to determine whether it explains unique variance in the dependent variable beyond other demographic and psychological factors.

7.2.2 Statistical Analyses and Results (RQ 2a)

Before conducting the main analyses, the distribution of the newly added variable, students' half-year GPA, was assessed and found to be nearly normal, with minor deviations. The slight left skew and platykurtosis were not statistically significant, and both the Kolmogorov-Smirnov and Shapiro-Wilk tests supported the assumption of normality. However, due to the non-normal distribution of several other psychological variables (see previous section), bootstrapping techniques were applied to all subsequent analyses where applicable. As a reminder, higher values on the GPA variable indicate better grades, unlike the raw grades in the German system where 1(+) is the best grade and 5/6 are failing grades.

Correlations between GPA, Grit, and Related Constructs. The bivariate correlations between students' GPA and other constructs, including grit, are presented in Table 7.4 (p. 153). GPA showed the strongest association with school engagement ($r = .447^{**}$), consistent with previous research (e.g., Datu et al., 2016; Muenks et al., 2017; Saleh et al., 2019; Steinmayr et al., 2018; Tang et al., 2019). The school engagement measure used in this study aligns with Fredricks et al.'s (2004) definition of *behavioral* engagement, and includes behaviors such as regular class attendance, bringing necessary materials, completing homework, actively participating in discussions, and working hard in school. These behaviors are pivotal for understanding and mastering course content, thereby influencing academic

Table 7.4*Descriptive Statistics and Correlations for Students' GPA (Time 1)*

	<i>n</i>	<i>M</i>	<i>SD</i>	Grit (gen.)	PE (gen.)	CI (gen.)	Grit (school)	PE (school)	CI (school)	Big- 5-C	ScBel	SSC	SSE	ToI	ScEng
GPA	188	.00	.84	.301**	.301**	.203**	.373**	.348**	.337**	.132	.151*	.292**	.406**	-.099	.447**

Bootstrapping was used for correlation coefficients to ensure robustness. Results are based on 1000 samples.

Gen. = domain-general; PE = Perseverance of effort (facet of grit); CI = Consistency of interests (facet of grit); Big-5-C = Conscientiousness; ScBel = School belonging; SSC = School self-control; SSE = School self-efficacy; ToI = Mindset / Implicit theories of intelligence; ScEng = School engagement

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

performance. Given that school engagement correlated most strongly with school grit ($r = .614^{**}$, see RQ 1) and is also the strongest covariate of GPA in this sample, it likely mediates the relationship between (school) grit and grades. Previous studies have shown engagement mediates the relationship between grit and various academic outcomes¹²¹ (e.g., Eroğlu & Kaya, 2023; Hodge et al., 2018; O'Neal et al., 2018; Z. Z. Wang & Lee, 2023), though none, to my knowledge, have focused specifically on school grades as an outcome. This hypothesis will be explored further in section 7.5.2 addressing RQ 2d.

School self-efficacy exhibited the second-strongest correlation with GPA ($r = .406^{**}$), followed by school grit ($r = .373^{**}$) and its two facets. Surprisingly, conscientiousness, often considered a robust predictor of academic achievement, showed only a weak and non-significant correlation with GPA in this sample. The weakest correlation was with mindset, though its negative direction aligns with findings in the growth mindset literature.

HMR: Predicting GPA with General Grit and Other Factors. A hierarchical multiple regression was conducted subsequently to examine the predictive power of SEA, gender, cohort, and several psychological factors, including overall general grit, on student GPA. The analysis proceeded in three steps, adding blocks of predictors at each stage.

Model 1 included SEA Index, gender, and cohort as predictors, explaining 19.8% of the variance in GPA, $R^2 = .198$, $F(3, 181) = 14.857$, $p < .001$. SEA ($\beta = .425$, $p < .001$) was a significant positive predictor of GPA, indicating that higher socio-economic advantage is associated with higher grades, while gender approached significance ($\beta = .125$, $p = .062$), and cohort (i.e., Grade 7 vs. 8) was not significant in this model ($\beta = -.025$, $p = .705$).

Model 2 added psychological factors (conscientiousness, school belonging, school self-control, school self-efficacy, and mindset), explaining 32.0% of the variance in GPA, $\Delta R^2 = .122$, $\Delta F(5, 176) = 6.323$, $p < .001$, which indicates a significant improvement over

¹²¹ One study suggested that grit may also moderate the relationship between academic engagement and academic achievement (E. G. Lee & Rhee, 2021).

Model 1¹²². SEA remained the strongest predictor ($\beta = .330, p < .001$), followed by school self-efficacy ($\beta = .253, p = .002$). Gender became significant ($\beta = .182, p = .005$), with female students earning higher grades than male students. Mindset emerged as a significant negative predictor of GPA ($\beta = -.162, p = .012$), consistent with findings linking a fixed mindset to poorer academic outcomes. Other factors, including conscientiousness, were not significant.

Model 3 introduced overall general grit as an additional explanatory variable, marginally improving the model to 32.9% explained variance, $\Delta R^2 = .009, \Delta F(1, 175) = 2.386, p = .124$. General grit, however, was not a significant predictor ($\beta = .139, p = .124$), and running the analysis with the separate general grit components instead of the overall score further reduced the F value of the third model, the significance of the F change, and the significance of the regression coefficients, indicating a worse model fit. This means that general grit does not explain unique variance in student GPA over and above the variables previously included in the model. As posited in the previous section, a context-specific measure of grit may be more relevant to GPA than a general measure of grit, an assumption that will be tested in the next analysis.

SEA remained the strongest predictor, followed by school self-efficacy, gender, mindset, and conscientiousness ($\beta = -.175, p = .038$), which became significant only once general grit was added. This suggests that controlling for general grit allowed the unique (negative!) influence of conscientiousness to emerge. General grit could be acting as a suppressor variable, meaning that the effect of conscientiousness was ‘suppressed’ by the omitted general grit variable. The fact that general grit is a weak predictor of GPA lends credence to this hypothesis, as suppressors raise observed R^2 mostly by accounting for the residuals left by models that omit them, and not through their own association with the DV, which is comparatively weak. Another potential explanation is that the relationship between GPA and conscientiousness may involve indirect effects or interactions that became apparent when general grit was added to the model. The surprising result that higher conscientiousness is linked to lower GPA in this sample may reflect over-commitment, burnout, or perfectionistic tendencies, such as task avoidance or procrastination, which hinder effective study habits. Additionally, conceptual overlap between conscientiousness and other predictors, despite no evidence of multicollinearity, could create redundancy in the regression

¹²² School engagement was purposefully omitted from this set of analyses due to the assumption that it may mediate the relationship between grit and students’ GPA (see RQ 2d below). If that were indeed the case, including it in the analyses for RQ 2a would diminish grit’s observed relationship with GPA to a large extent, thus rendering the attempt to establish grit’s individual contribution meaningless. The results of the regression analyses that include engagement in addition to grit are thus presented in the results section (7.5.2) for RQ 2d.

model and distort the unique variance attributed to conscientiousness.

In summary, higher SEA, school self-efficacy, and being female were associated with higher GPA, while higher conscientiousness and a fixed mindset were linked to lower grades.

HMR: Predicting GPA with School Grit and Other Factors. The analogous analysis with school grit added in the final step, after demographic and psychological variables, paints a different picture (see Table 7.5, below). The final model explained 34.2% of the variance in grades, $\Delta R^2 = .023$, $\Delta F(1, 175) = 5.989$, $p = .015$, indicating a significant improvement over Model 2. SEA Index ($\beta = .328$, $p < .001$) emerged once again as the strongest predictor, followed by *overall school grit* ($b = .256$, $\beta = .238$, $p = .015$). Each unit increase in school grit corresponds to a .256-unit rise in GPA, showing that students with higher levels of school grit perform better.

When the individual components of school grit replaced the composite measure in the final step, the total variance explained did not change, but neither component emerged as a significant predictor. This suggests that the composite school grit measure captures the aspects of grit relevant to academic performance more effectively, potentially due to reduced

Table 7.5

Hierarchical Multiple Regression Predicting Student GPA at Time 1

	<i>b</i>	<i>SE b</i>	β	<i>t</i>	<i>p</i>	95% CI for <i>b</i>		<i>R</i>	<i>R</i> ²	ΔR^2	ΔF	<i>p</i> (ΔF)
						<i>LL</i>	<i>UL</i>					
Model 1								.445	.198		14.857	<.001
(Constant)	.213	.863		.247	.805	-1.490	1.917					
Cohort	-.043	.114	-.025	-.380	.705	-.268	.181					
Gender	.212	.113	.125	1.876	.062	-.011	.436					
SES Index	.460	.072	.425	6.368	<.001	.317	.602					
Model 2								.565	.320	.122	6.323	<.001
(Constant)	.049	.834		.059	.953	-1.596	1.694					
Cohort	-.029	.110	-.017	-.261	.794	-.245	.188					
Gender	.310	.108	.182	2.856	.005	.096	.524					
SES Index	.357	.072	.330	4.952	<.001	.215	.499					
Conscientiousness	-.108	.071	-.111	-1.524	.129	-.249	.032					
School belonging	.083	.073	.076	1.141	.256	-.061	.226					
School self-control	.101	.062	.135	1.640	.103	-.021	.222					
School self-efficacy	.190	.061	.253	3.094	.002	.069	.311					
Mindset	-.128	.050	-.162	-2.544	.012	-.227	-.029					
Model 3								.585	.342	.023	5.989	.015
(Constant)	-.139	.826		-.169	.866	-1.769	1.490					
Cohort	-.001	.109	-.001	-.009	.993	-.216	.214					
Gender	.262	.109	.154	2.414	.017	.048	.477					
SES Index	.354	.071	.328	4.987	<.001	.214	.495					
Conscientiousness	-.187	.077	-.192	-2.424	.016	-.339	-.035					
School belonging	.076	.072	.069	1.052	.294	-.066	.217					
School self-control	.045	.065	.060	.686	.493	-.084	.173					
School self-efficacy	.138	.064	.184	2.159	.032	.012	.265					
Mindset	-.128	.049	-.162	-2.586	.011	-.226	-.030					
School grit	.256	.105	.238	2.447	.015	.050	.462					

measurement error, higher construct validity, or an aggregation effect. The lack of significance for the components may also reflect multicollinearity, given their strong intercorrelations (see RQ 1), which could diminish the unique contribution of each facet.

School self-efficacy ($\beta = .184, p = .032$), mindset ($\beta = -.162, p = .011$), gender ($\beta = .154, p = .017$), and conscientiousness ($\beta = -.192, p = .016$) were further significant predictors in the final model, mirroring the findings from the analysis with general grit. Once again, conscientiousness emerged as a significant negative factor only in the final model, after not being significant in the previous block of independent variables.

Summing up, higher SEA, school grit, school self-efficacy, and being female are associated with higher grades, while a fixed mindset and higher conscientiousness are linked to lower grades. The supposition that school grit is likely to be a stronger predictor of students' GPA, based on the previous finding that it is more closely associated with school engagement than its domain-general counterpart (see RQ 1), was thus confirmed. The findings underscore the importance of context-specific measures, like school grit, in predicting educational outcomes.

But what does it *mean* that school grit explains 2.3% unique variance in grades, even after controlling for school self-efficacy and conscientiousness (well-established predictors of academic performance), school self-control, and others? How much of the explanatory power grit shares with its correlates is, in fact, assigned to these other variables? And what does its second-highest beta coefficient, after socio-educational advantage, reveal about its predictive importance? The analyses in the next section aim to address these questions regarding grit's relative contribution to GPA.

7.3 Research Question 2b

7.3.1 Method Overview (RQ 2b)

Simple indices such as zero-order correlations or traditional regression weights are insufficiently apt measures of relative importance in the context of multiple correlated predictors. Bivariate correlations consider each variable to be independent of others, while regression coefficients reflect the relationship between a predictor and a criterion while all other variables are held constant. In order to know whether a predictor is meaningful over and above chance levels, one needs to determine that predictor's relative importance—i.e., the proportionate contribution it makes to R^2 , taking into account both independent and joint relationships between correlated predictors and outcome—and the statistical significance of said relative weight. Methods like dominance analysis and relative weight analysis provide satisfactory estimates of predictor importance in the context of multiple correlated predictors,

ideally producing very similar results when applied to the same data (Tonidandel et al., 2009).

In the following section, a relative weight analysis (RWA) is conducted using the RWA Web tool¹²³ to determine the relative importance of *school* grit compared to other related constructs (e.g., school self-efficacy) in predicting school performance. RWA, also known as relative importance analysis (Tonidandel et al., 2009), is particularly useful when predictors are highly intercorrelated and traditional regression coefficients may not accurately reflect their importance. This method produces raw relative weights (epsilon weights, ϵ) and rescaled weights (expressed as a percentage of *predictable* variance) for each predictor in the model. It also determines the statistical significance of these relative weights and tests whether the weight of one predictor significantly differs from others. Confidence intervals and significance tests are based on multiple bootstrapped replications, with 10,000 iterations used in this analysis. For a discussion of the merits of using RWA in a comparable research context—assessing the importance of grit and further predictors for school grades—see Steinmayr et al. (2018).

To corroborate the findings of the RWA and address potential limitations inherent to this method, a dominance analysis (DA) is also performed using R. The DA complements the RWA by examining the consistency of predictors' contributions across all possible subset models. This dual approach serves as a form of methodological triangulation, strengthening the validity of results and offering a more nuanced understanding of predictor importance.

7.3.2 Statistical Analyses and Results (RQ 2b)

The results of the RWA are presented in Table 7.6 (p. 159). The predictors collectively explained approximately 34.1% of the variance in students' GPA, nearly identical to the R^2 from the final hierarchical regression model (34.2%, see RQ 2a). SEA was the strongest contributor, accounting for 37% of the *explained* variance in GPA (12.6% of the total variance), and this contribution was significant. School self-efficacy followed, contributing about 20% of the explained variance (6.8% of the total variance), while school grit accounted for approximately 17% (5.8% of the total variance). None of the other predictors' relative weights were significant at the .05 level, and the relative rescaled weights of cohort, conscientiousness, and school belonging (all below 4%) were significantly lower than that of school grit. In other words, grit's relative weight was not significantly different from that of school self-efficacy and SEA, denoting that it also contributes considerably to the explained variance in GPA.

¹²³ This tool is made available by the main RWA researchers, Scott Tonidandel and James M. LeBreton at <https://rwa-web.shinyapps.io/multipleregression/>

In the dominance analysis (DA), the relative importance of each predictor was assessed using their General Dominance (GD) values. These values represent the average contribution of each predictor to the model's R^2 across all possible subset models. The results of this additional analysis are also included in Table 7.6 and visualized in Figure 7.2 (below).

A comparison of DA and RWA outcomes shows that the total variance in GPA explained by the predictors is identical, and the predictors' rescaled weights (proportionate contributions to R^2) are extremely similar, with the largest difference between two indices being just 0.04% of the overall variance in GPA. The DA also provides a General Dominance matrix, which evaluates whether one predictor dominates another across models of all sizes. School grit exhibits complete general dominance over all other predictors except SEA and school self-efficacy, which remain stronger contributors in this model.

Both the GD measure and the relative weight measure identify overall school grit as the third most important, statistically significant, predictor of students' GPA, accounting for approximately 17% of the explained criterion variance. Students with higher SEA, greater self-efficacy, and higher school grit tend to earn better grades than their peers.

An alternative model replacing overall school grit with its components, school perseverance and school consistency, explains nearly the same variance in GPA (34.17% vs. 34.08%). However, the distribution of explanatory power shifts, with perseverance and

Figure 7.2

Dominance Analysis: Relative Contributions of Predictors to GPA (Time 1)

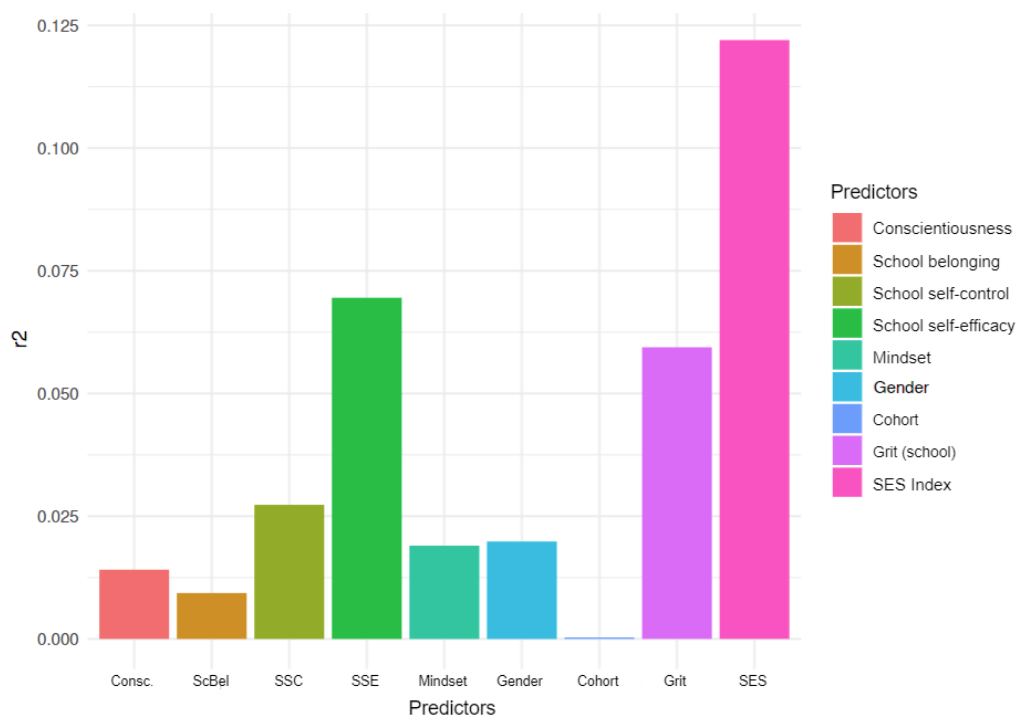


Table 7.6*Relative Weights and Percentage of Explained Criterion Variance for all Predictors (Time 1)*

Predictors	ε	%	GD	ε	%	GD
Cohort	0.0004 ^a	0.11 ^a	0.000	0.0004 ^{bc}	0.12 ^{bc}	0.000
Gender	0.0203	5.96	0.020	0.0195	5.72	0.019
SES Index	0.1261	37	0.122	0.1244 ^{bc}	36.42 ^{bc}	0.120
Conscientiousness	0.0098 ^a	2.88 ^a	0.014	0.009 ^b	2.64 ^b	0.014
School belonging	0.011 ^a	3.23 ^a	0.009	0.0103	3.02	0.009
School self-control	0.0296	8.69	0.027	0.025 ^d	7.32 ^d	0.023
School self-efficacy	0.068	19.96	0.070	0.0619	18.12	0.064
Mindset	0.018	5.27	0.019	0.0184	5.38	0.020
Grit (school)	0.0576	16.89	0.059	–	–	–
Perseverance (school)	–	–	–	0.0384 ^d	11.25 ^d	0.039
Consistency (school)	–	–	–	0.0342 ^d	10.02 ^d	0.034
R^2 / PEV	0.3408	100	0.3408	0.3417	100	0.3417

Note. $n = 188$; Criterion = GPA (January 2019; T1); ε = raw relative weight (RWA); % = rescaled relative weight (RWA); GD = general dominance (DA); PEV = proportion of explained variance. Relative weights printed in bold are statistically significant ($p < .05$).

^a Relative weight differs significantly from that of Grit (school) ($p < .05$).

^b Relative weight differs significantly from that of Perseverance (school) ($p < .05$).

^c Relative weight differs significantly from that of Consistency (school) ($p < .05$).

^d Bootstrapping resampling can lead to fluctuations in the estimated confidence intervals, particularly for predictors with smaller effect sizes or in datasets with high variability. As a result, this predictor was non-significant in a few iterations.

consistency each contributing 10–11% of the explained variance (see Table 7.6). Combined, the two components explain more variance than the aggregate school grit measure did in the reduced model (21% vs. 17%) and are a stronger predictor than self-efficacy in the extended model (21% vs. 18%), with SEA remaining the strongest predictor in this latter configuration.

Even though this finding seems to contradict the results of the regression analysis, in which the separate components, unlike overall school grit, were *not* significant predictors of GPA, it must be noted that a minority of the RWA bootstrapping iterations determined that the (individually lower) separate component weights are not statistically significant. This phenomenon underlines the importance of considering the inherent uncertainty in bootstrap estimates, particularly for predictors with smaller effects or in datasets with high variability.

7.4 Research Question 2c

7.4.1 Method Overview (RQ 2c)

The analyses in the following section aim to determine whether the effect of school grit on GPA is moderated by students' socio-educational advantage (SEA), gender, cohort, or academic ability. To explore these potential moderation effects, Andrew F. Hayes' PROCESS

macro (SPSS version) is employed for the first three moderators, while a hierarchical multiple regression with interaction terms is used for academic ability. This dual approach ensures the appropriate methodology is applied for each moderator.

The PROCESS macro provides a streamlined and user-friendly interface designed specifically for mediation, moderation, and conditional process modeling. Unlike standard SPSS regression tools, which lack built-in functions for computing and interpreting interaction effects, PROCESS automates these calculations, generates relevant statistics, and provides bootstrapped confidence intervals for interaction terms¹²⁴.

While highly effective for traditional moderation analysis, where the moderator is conceptually distinct from both the independent and dependent variables, PROCESS is unsuitable for testing the moderation effect of *academic ability*. In this context, academic ability is coded as a categorical variable with four levels: ‘Low GPA’ (bottom 25th percentile), ‘Lower Middle GPA’ (25th-50th percentile), ‘Upper Middle GPA’ (50th-75th percentile), and ‘High GPA’ (top 25th percentile). Essentially, this is a differently coded version of the dependent variable, which is a continuous GPA measure. There are instances in research where the effect of an IV on a DV might be hypothesized to vary based on different levels of the DV itself. This can occur when the DV is measured at an earlier time point (as a baseline or pre-treatment measure) or—as is the case here—the researcher is interested in examining whether the relationship between the IV and DV differs across categories (e.g., low, medium, high performance) of the DV. Using a recoded version of the DV as a moderator within the PROCESS framework violates the assumptions and intended structure of the macro, leading to several issues with interpretation and statistical validity: e.g., the close relationship between the DV and the moderator inflates the model’s explanatory power, the IV’s effect is dwarfed by the moderator, which captures most of the variance in the outcome variable, and the interactions cannot be interpreted meaningfully.

In traditional regression, however, interaction terms can be used to assess whether the relationship between an IV and a DV varies across different levels of another variable (moderator). This approach allows for baseline or recoded versions of the dependent variable to be utilized as moderators. For this analysis, the interaction term, calculated as the product of the IV (school grit) and dummy-coded categorical variables for academic ability, reveals whether the effect of grit on GPA varies across different levels of academic ability.

¹²⁴ For more information about the PROCESS macro, see <https://processmacro.org/index.html>

7.4.2 Statistical Analyses and Results (RQ 2c)

Starting with the non-significant results, cohort (whether the student is in Grade 7 or 8) does not moderate the relationship between school grit and grades. The interaction term is not significant ($p = .849$), it does not explain any additional variance in the DV, $\Delta R^2 = .000$, $F(1, 183) = 0.036$, and the effect of school grit on grades is equally strong and significant at both levels of the moderating variable. This result does not change when adding all other variables as covariates in the model. Although some evidence in the literature suggests that grit tends to increase with age, potentially resulting in a stronger association between grit and grades among Grade 8 students, this pattern is not observed in the current sample.

Gender is also not a moderator of the relationship between grit and GPA. Though female students have somewhat higher school grit ($r = .153^*$) and gender was a significant positive predictor of GPA in prior multiple regression analyses (see RQ 2a), grit's association with GPA does not differ for male and female students in this sample, $\Delta R^2 = 0.00$, $F(1, 183) = 0.027$, $p = .868$. Once again, this non-result applies to models with or without covariates.

Students' level of SEA, on the other hand, emerges as a clear moderator. The model without covariates explains 27.58% of the variance in GPA and is highly significant ($p < .001$). The interaction (school grit * SEA) has a regression coefficient of $-.194$ ($p = .025$), indicating that the relationship between school grit and GPA is contingent upon students' SEA. Conditional effects show that school grit has a stronger positive association with GPA at low and moderate SEA levels ($b = .488$, $p < .001$, 95% CI $[.274, .703]$ and $b = .343$, $p < .001$, 95% CI $[.201, .485]$), while the effect becomes nonsignificant at high SEA levels ($b = .160$, $p = .087$, 95% CI $[-.024, .344]$). Bootstrap results confirm the stability of these estimates.

A more comprehensive model controlling for additional variables¹²⁵ explains 35.78% of criterion variance ($p < .001$) and the interaction between school grit and SEA remains significant ($b = -0.173$, $\Delta R^2 = 0.015$, $F(1, 174) = 4.201$, $p = .041$). The conditional effects mimic those reported above, with decreasing effect sizes and significance values for increasing levels of SEA ($p = .001$ for low SEA, $p = .006$ for moderate SEA and $p = .298$ for high SEA). In both cases, the effect is strongest at low levels of SEA and weakest (and nonsignificant) at high levels of SEA, as illustrated by the steepness of the conditional effect slopes in the graph on the next page (Figure 7.3, p. 162).

These findings suggest that school grit is a more important predictor of grades for

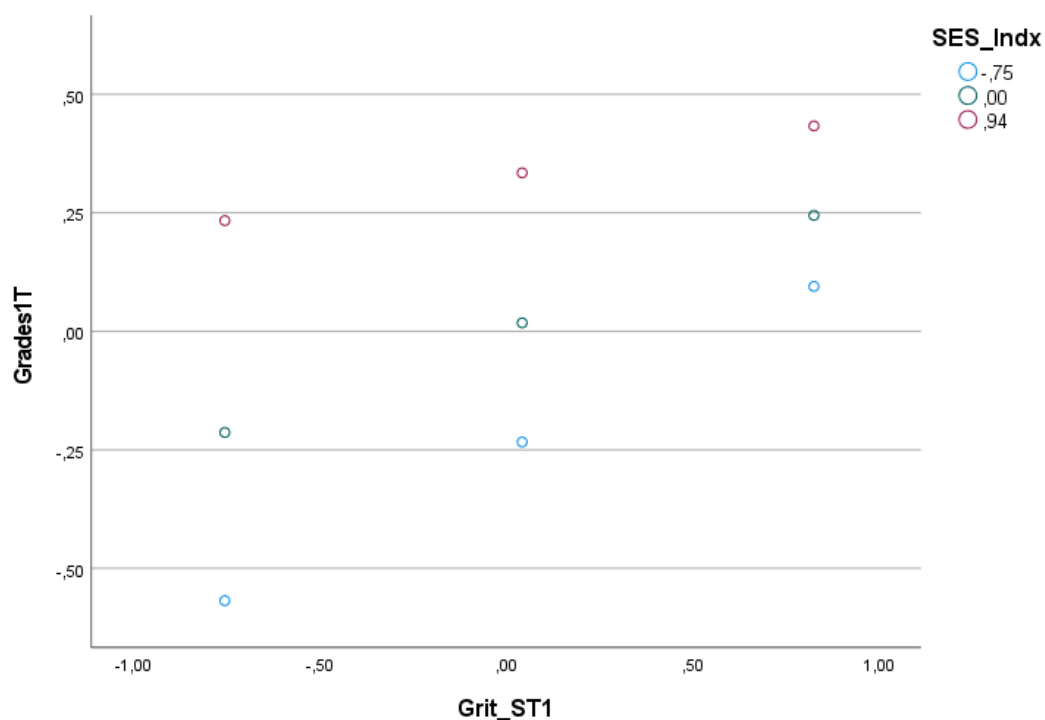
¹²⁵ i.e., cohort, gender, conscientiousness, school belonging, school self-control, school self-efficacy, and mindset. Controlling for correlates of grit ensures that the observed effects are more specifically attributable to grit rather than to its shared variance with other variables. Furthermore, by accounting for additional variance in the DV, covariates can increase the precision of the estimates for the effects of the main variables of interest.

students with lower SEA. Prior research has shown that non-cognitive skills are stratified by family socioeconomic status, with students from disadvantaged backgrounds typically scoring lower on these measures (e.g., A. Liu, 2020). This aligns with the current data, where, apart from mindset, all psychological factors that typically enable students to do well in school and beyond are positively and significantly correlated with SEA ($r = .156^*$ to $r = .362^{**}$). In other words, students with higher SEA tend to exhibit greater school grit, self-control, or self-efficacy than their peers. As a result, higher levels of school grit may be particularly important for disadvantaged students and may have a greater impact on their academic outcomes. Liu (2019) further suggests that higher non-cognitive skills will lessen family SES's effects on achievement during childhood and adolescence. Consequently, interventions aimed at increasing grit may therefore be particularly beneficial—in terms of their potential impact on academic performance—for students from lower socioeconomic backgrounds (or with lower levels of SEA), which is a central hypothesis of this doctoral project (see WH 5 in Ch. 8).

Last but not least, the hierarchical multiple regression with school grit and interaction terms for academic ability levels reveals that the relationship between school grit and GPA is moderated by GPA levels, even after controlling for covariates. More specifically, the

Figure 7.3

Moderation Effect of SEA on the Relationship between School Grit and GPA



Note. Each set of points represents the predicted values of GPA (Grades1T) for different levels of school grit (Grit_ST1) at specific levels of SEA (SES_Indx).

interaction term between school grit and Low GPA (bottom 25th percentile) is positive and non-significant ($\beta = .093, p = .283$), indicating no significant difference in the association between school grit and GPA compared to the reference category (High GPA). Both groups follow a similar trend: higher school grit is associated with better grades. For students with Lower Medium GPA ($\beta = -.203, p = .022$), the significant negative interaction suggests that in this group, higher school grit is associated with a weaker or even negative relationship with GPA compared to the High GPA group. For students with Upper Medium GPA (50-75th percentile), the marginally significant negative interaction ($\beta = -.162, p = .052$, bootstrapped $p = .035$, 95% CI $[-.736, -.060]$) reveals a similar trend to the Lower Medium GPA group, where higher grit has a less positive or potentially negative association with GPA relative to the High GPA group. Thus, the strongest association between school grit and GPA is observed for students with the lowest level of academic ability, followed by those with the highest level of ability, while for students with average academic ability, the association between school grit and grades is less pronounced. These different trajectories can be seen more clearly in the graph on the next page (Figure 7.4, p. 164)¹²⁶.

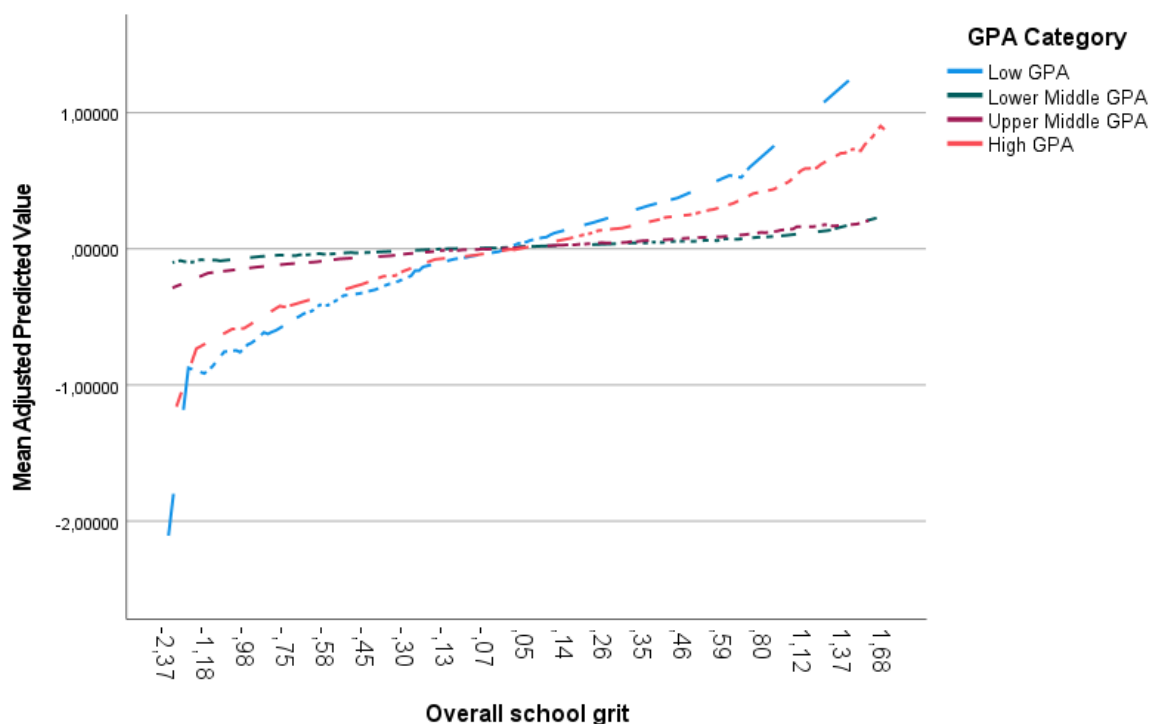
For high-performing students, the positive impact of grit on grades may be more pronounced because these students have the foundational skills to leverage their grit effectively. Moreover, they likely have fewer external barriers affecting their performance, so the role of grit in optimizing their performance becomes more evident. For the lowest-performing students, grit may be a critical factor in their efforts to overcome academic struggles. Even small increases in effort and persistence—potentially enabled by grit—may yield noticeable improvements in GPA in this group. Moreover, grit might serve as a crucial psychological resource that contributes to overcoming non-academic barriers, such as lack of resources or familial support. For students with average GPA levels, the weaker associations may reflect a plateau effect or diminishing returns, where grit alone is less effective without accompanying improvements in other skills.

These assumptions align with findings indicating that grit exerts its greatest influence at the highest and lowest ends of the cognitive ability spectrum. For high-ability students, grit enhances self-regulated learning as they tackle challenging tasks, whereas for low-ability students, grit serves a compensatory role, allowing effort to substitute for cognitive ability in

¹²⁶ In the analogue analysis with the extended set of variables, cohort, gender, SEA Index, conscientiousness, school belonging, school self-efficacy, and mindset were entered (as controls) in the first block, school grit was entered in the second block, and the interaction terms between school grit and GPA categories were entered in the third block. The coefficients and their significance followed the same pattern as in the reduced version of the regression: Low GPA, $b = .035, \beta = .015, t(172) = .188, p = .851$; LM GPA, $b = -.643, \beta = -.286, t(172) = -3.625, p < .001$; UM GPA, $b = -.350, \beta = -.146, t(172) = -1.961, p = .051$, bootstrapped $p = .021$, 95% CI $[-.646, -.037]$.

Figure 7.4

Moderation Effect of Academic Ability on the Relationship between School Grit and GPA



achieving academic success (Light & Nencka, 2019). Since high-performing students are less likely to require targeted interventions, as they already have the resources to maximize their academic outcomes, interventions targeting grit may prioritize students with low SEA (see previous analysis) and low academic ability, for whom increases in effort and persistence are more likely to bring about significant improvements in academic performance.

7.5 Research Question 2d

7.5.1 Method Overview (RQ 2d)

As school engagement likely represents the core behavioral mechanism through which grit and other non-cognitive skills improve academic outcomes—and given its strong correlations with both school grit ($r = .614^{**}$, see RQ 1) and GPA in this sample ($r = .447^{**}$, see RQ 2a)—I hypothesized that school engagement mediates the relationship between school grit and students' GPA. The section first revisits the analyses addressing RQ 2a and RQ 2b, incorporating school engagement as an additional variable. This is followed by the main mediation analysis, conducted using Hayes' PROCESS macro, which provides a user-friendly approach to estimating direct, indirect, and total effects, along with bootstrapping for more accurate confidence intervals.

7.5.2 Statistical Analyses and Results (RQ 2d)

The first empirically derived indication that school engagement may mediate grit's association with GPA was the disappearance of the significant effect of school grit on GPA when school engagement was added in the fourth block of the hierarchical multiple regression analysis previously described in section 7.2.2 (RQ 2a). While engagement was the strongest predictor in this final model ($b = .675$, $\beta = .310$, $p < .001$), school grit's significance dropped from $p = .015$ to $p = .447$, along with a predictable drop in coefficient sizes (from $b = .256$, $\beta = .238$ to $b = .084$, $\beta = .078$).

When engagement was included in the relative weight analysis and dominance analysis (RQ 2b)—alongside school grit and the other variables of interest—it predictably fared well in terms of relative importance, placing second after SEA and contributing 24.5% of the *explained* variance in GPA (9.7% of the overall variance). School self-efficacy was relegated to the third place (explaining about 16% of criterion variance) and school grit dropped to the fourth place (explaining 10% of criterion variance). On average and across models of all sizes, school engagement was shown to dominate grit, meaning that it is a stronger predictor of grades than school grit. Nonetheless, the relative weight of school grit remained significant at the .05 level.

These preliminary results served as an endorsement of the proposed mediation effect, which was tested using the mediation model 4 in the PROCESS macro, which looks at both direct and indirect effects (Table 7.7, p. 166). Path *a* (denoting the effect of school grit on school engagement), had a R^2 of .405 ($F(1, 185) = 126.031$, $p < .001$), meaning that 40.52% of the variance in school engagement is explained by school grit ($b = .312$, $\beta = .636$, $p < .001$). A one-unit increase in school grit is associated with a 0.312 unit increase in school engagement, holding all else constant. Path *b* (denoting the effect of school engagement on GPA), had a R^2 of .211 ($F(2, 184) = 24.595$, $p < .001$), indicating that 21.09% of the variance in grades is explained by the model that includes both school grit and school engagement. A one-unit increase in school engagement is associated with a 0.764 unit increase in grades ($b = .764$, $\beta = .351$, $p < .001$). Path *c* (denoting the total effect of school grit on GPA) was also significant ($R^2 = .137$, $F(1, 185) = 29.453$, $p < .001$), indicating that school grit positively and significantly predicts grades when the direct and indirect effects (through the mediator) are combined ($b = .395$, $\beta = .370$, $p < .001$). Path *c'* (representing the direct effect of school grit on GPA, after separating out the contribution of school engagement) was no longer significant at the .05 level ($b = .156$, $\beta = .146$, $p = .085$). The indirect effect (*ab*) of school grit on GPA *through* school engagement was significant ($b = .238$, $\beta = .223$, 95% CI [.128, .370]),

Table 7.7*The Effects of School Grit on GPA Mediated by School Engagement (Time 1)*

Path	b^*	$SE\ b^*$	β	t	p	95% CI for b^*		R^2
						LL	UL	
Grit $\rightarrow$ ScEng (a)	.3125	.0278	.6366	11.23	< .001	.2575	.3674	.4052
ScEng $\rightarrow$ GPA (b)	.7645	.1845	.3518	4.14	< .001	.4005	1.1286	–
Grit $\rightarrow$ GPA (c'), DE	.1565	.0906	.1467	1.73	.086	-.0222	.3352	–
Grit $\rightarrow$ GPA (c), TE	.3954	.0728	.3706	5.43	< .001	.2516	.5391	.1373
Indirect effect (ab)	.2389	.0608 ^a	.2239	–	Sig. ^b	.1284 ^c	.3702 ^c	–
Full model (abc')	–	–	–	–	–	–	–	.2109
	F	$df1$	$df2$					
Interaction Test (X by M)	2.449	1	183		.119			

Note. Grit = school grit, ScEng = School engagement, DE = Direct effect, TE = Total effect

* Denotes an unstandardized regression coefficient, not to be confused with path b .

^a Unstandardized bootstrapped standard error

^b The indirect effect is significant if 0 is not included in the bootstrapped confidence interval.

^c Unstandardized bootstrapped confidence intervals

indicating that school engagement mediates the relationship between grit and grades. Finally, the interaction between school grit and school engagement ($X * M$) was not significant ($p = .119$), indicating that the mediation effect is consistent across different levels of engagement.

In summary, school engagement fully mediates the relationship between school grit and GPA, as the direct effect becomes nonsignificant once engagement is included. Put differently, school engagement is a pathway through which grit is associated with grades. However, if the direct effect ($p = .085$) were considered marginally significant, this could indicate partial mediation, with a small portion of grit's effect on grades independent of engagement. Furthermore, the mediation model explains a substantial portion of variance in both engagement and grades, underscoring the critical role of these constructs in understanding academic performance.

The abovementioned findings are robust even after controlling for cohort, gender, SEA, conscientiousness, school belonging, school self-control, school self-efficacy, and mindset. In the enlarged model, school grit is still by far the strongest predictor of school engagement ($\beta = .518, p < .001$); school engagement is the strongest predictor of GPA ($\beta = .309, p < .001$), followed by SEA; school grit has a significant total effect on grades ($\beta = .238, p = .015$), but its direct effect is nonsignificant after accounting for the mediator (engagement) and controlling for covariates ($\beta = .077, p = .447$); and, most importantly, the indirect effect through engagement is significant, as the CI excludes zero ($b = .172, \beta = .160, 95\% \text{ CI } [.067,$

.303]), confirming that engagement mediates the relationship between school grit and GPA.

The persistence of the mediation effect, even after accounting for other variables, reinforces the validity of these findings by showing that the observed mediation is not merely a result of extraneous factors. Instead, grit's influence on GPA operates primarily through school engagement. This, in turn, signals that interventions aimed at increasing grit may be effective in improving academic performance, particularly by fostering greater engagement.

7.6 Addendum: The Choice of Cohort over Class

Given that the primary objective of the present cross-sectional study was to examine the relationships between grit, its correlates, and GPA, class membership was not a focal variable. Instead, cohort was used as a control variable in analyses reported in this chapter.

Sensitivity analyses¹²⁷ partialing for class instead of cohort did not generate substantially different results when it comes to key variables or their significance as predictors. For example, in the regression analysis predicting school grit (RQ 1), class dummy variables in Model 1 explained more variance than cohort ($R^2 = .170$ vs. $R^2 = .084$). However, the final models (Model 2), which included seven additional psychological variables, had identical significant predictors and were nearly identical in terms of explained variance (69% vs. 67.8%), significance levels, and coefficient sizes (e.g., for the general grit residual, $b = -.249$, $\beta = -.135$, $p = .003$ with class dummies vs. $b = -.248$, $\beta = -.135$, $p = .002$ with cohort). This pattern extended—with varying degrees of similarity—to the regression models predicting general grit (RQ 1), students' GPA at Time 1 (RQ 2a), the relative weight analyses (RQ 2b), the hierarchical regression with interaction terms probing the moderating role of academic ability (RQ 2c), and the moderation and mediation analyses carried out using the PROCESS macro (RQ 2c and RQ 2d).

Thus, class membership, just like cohort, does not appear to be significantly associated with any of the key constructs under analysis, including grit and students' grades¹²⁸. As cohort differences may reflect developmental changes and the impact of different curricula, which are more likely to influence the dependent variables than class-specific factors, cohort was prioritized as a covariate due to its conceptual relevance.

¹²⁷ Sensitivity analyses are meant to test the robustness of the results by examining how these change when one varies certain conditions or assumptions (such as the inclusion of different covariates) in the model.

¹²⁸ In cluster sampling, participants within a cluster may not be independent, as their responses could correlate due to shared environmental factors (e.g., teacher quality, classroom dynamics). The intraclass correlation coefficient (ICC) quantifies the extent to which observations within the same group (e.g., class) are more similar to each other than to those in other groups. However, sensitivity analyses in this study indicate that 'class effects' played a limited role. Additionally, the 12 classes were randomly assigned to conditions, further minimizing potential clustering effects. For these reasons, ICC was not calculated or accounted for directly in this study.

7.7 Conclusion

The answer to RQ 1 (“How do domain-general and school-specific grit relate to other constructs in their nomological network?”) is multifaceted. Key findings indicate that general and (particularly) school grit are strongly correlated with conscientiousness, self-efficacy, self-control, and engagement. While school and general grit are positively related overall, their residuals show a negative association, suggesting potential trade-offs in grit expression across domains. These insights highlight the complexity of grit’s role in school and suggest that grit interventions could significantly benefit engagement and other academic outcomes.

Analyses addressing RQ 2a (“How strongly do students’ grit and the other variables relate to students’ overall GPA? Do the grit variables explain unique variance in GPA over and above the other constructs?”) reveal that school grit, higher SEA, self-efficacy, and being female are associated with higher grades, while general grit is not a significant predictor of GPA. In contrast, higher conscientiousness and a fixed mindset are linked to lower grades. The findings confirm that school grit uniquely contributes to explaining variance in GPA beyond other constructs and serves as a more relevant predictor of academic performance than general grit, highlighting the value of context-specific measures in educational settings.

The findings for RQ 2b (“What is the relative importance of the grit variables for GPA when including all other predictors simultaneously in the analytic model?”) show that school grit alone accounts for approximately 17–21% of the explained variance in students’ GPA, making it the third most important predictor after SEA and school self-efficacy. These results, consistent across relative weight analysis (RWA) and dominance analysis (DA), reinforce the significant role of school grit in academic performance.

RQ 2c asked, “Is the impact of grit on GPA moderated by students’ socio-economic status, gender, cohort, or academic ability?” The results indicate that neither cohort nor gender moderates the relationship between school grit and grades. However, SEA significantly moderates this relationship, with school grit having a stronger positive effect on grades for students with low and moderate SEA compared to those with high SEA. Academic ability also moderates the relationship, with the strongest associations between school grit and grades observed in students with the lowest *and* highest GPA levels.

Finally, the analyses addressing RQ 2d, “Is the impact of grit on GPA mediated by students’ school engagement?” confirm that school engagement mediates the relationship between grit and academic performance. This mediation effect is robust, persisting even after controlling for various covariates. Notably, school engagement is a stronger predictor of grades than school grit, underscoring its critical role in translating grit into academic success.

8 Quantitative Strand: A Longitudinal Analysis of the Academic and Behavioral Outcomes of Grit Interventions

This chapter examines the effects of two brief, web-based grit interventions—targeting academic mindsets (AM) and learning skills and strategies (LSS)—and a combined approach (COMB), on various DVs. The intention was to verify the extent to which grit is trait- or skill-like by assessing its responsiveness to interventions (see Credé et al., 2017; Eskreis-Winkler, Gross, et al., 2016; Rimfeld et al., 2016) and determining which type of intervention may have been most effective. Secondly, it was important to investigate factors that might influence or moderate the relationship between the grit interventions and achievement. This includes the effectiveness of grit interventions in certain settings or for particular types of goals (commonly referred to as the performance domain, see also Duckworth & Quinn, 2009), and the interventions' potentially different impact on certain types of students (disadvantaged vs. advantaged, or most vs. least academically able, see also Eskreis-Winkler, Gross, et al., 2016). Thirdly, more research was needed on behavioral mechanisms that may partially or fully explain (or mediate) the effect of the interventions on various academic outcomes.

For this reason, the DVs included a) self-reported measures of general and school grit, and b) other variables of interest such as mindset, school self-control, and school belonging (assessed at Time 1, pre-intervention, and at Time 2, eight months post-intervention), c) the achievement of self-selected personal and academic goals (measured eight months post-intervention), d) grades / GPA (collected over a period of two and a half school years), e) students' academic progress as evaluated by teachers (measured three months post-intervention), and f) students' educational attainment (measured five years post-intervention).

The following research questions (RQ) are addressed in the present chapter:

- » RQ 3x: How do the one-time web-based grit interventions affect ...
 - a: self-reported levels of domain-general and school-specific grit over time?
 - b: self-reported levels of conscientiousness, school belonging, school self-control, school self-efficacy, and fixed / growth mindset over time?
 - c: self-reported levels of school engagement over time?
 - d: the achievement of self-selected personal and school goals post-intervention?
 - e: students' GPA over time?
 - f: students' academic progress as evaluated by teachers post-intervention?
 - g: students' educational attainment?

The working hypothesis, WH 3, supported by evidence from Alan et al. (2019), Duckworth et al. (2016), Duckworth, Kirby, et al. (2013); Eskreis-Winkler, Shulman, et al. (2016), Santos et al. (2021), Walton and Cohen (2011), Yeager et al. (2014), Yeager, Romero, et al. (2016), and Yeager, Walton, et al. (2016) posits that participants in the treatment conditions will improve more on measures of academic performance and report greater achievement of self-selected goals than those in the control group. These effects are likely to occur due to changes in the personality *state*—the material manifestation of being gritty—but recurrent or enduring engagement in changed personality states would be needed for changes in people’s self-concept, and consequently, their personality *trait* (Bleidorn et al., 2019). Accordingly, I hypothesize that the interventions will have a significantly stronger effect on outcomes listed under 3c–g compared to self-reported personality measures (3a–b).

- » RQ 4: Which is the most effective grit intervention with respect to any of the outcomes measured in this study?

The WH 4 builds on models of non-cognitive factors influencing academic outcomes proposed by Farrington et al. (2012), Snipes et al. (2012), and SRI International (2018). It also draws on findings from Eskreis-Winkler, Shulman, et al. (2016), who showed that teaching the principles of deliberate practice without a motivational component addressing self-relevant expectancies and values did not lead to improvements in practice behavior or academic achievement. WH 4 posits that participants in the COMB condition will show greater improvements in academic measures and report higher achievement of self-selected goals than those in either the AM-only or LSS-only conditions. The rationale, detailed in the theoretical background, is that achieving optimal positive outcomes likely requires both the ‘right’ mindset and the necessary skills to translate intervention stimuli into success.

- » RQ 5: Which groups of students benefit more from any of the interventions than their peers? Are the interventions particularly effective for socially disadvantaged or poorly performing students?

The WH 5, supported by evidence from Claro et al. (2016), Paunesku et al. (2015), Tough (2016), Santos et al. (2021), Yeager and Dweck (2012), and Yeager, Walton, et al. (2016), posits that students who are socio-educationally disadvantaged and those who are academically weak experience greater improvements in academic achievement compared to their peers, due to both intervention and potential ceiling effects.

- » RQ 6: What are the mechanisms underlying the effect of the grit interventions on GPA? Is students’ school engagement mediating this relationship?

The WH 6, drawing on insights from Duckworth, Kirby, et al. (2011), Eskreis-

Winkler, Shulman, et al. (2016), Farrington et al. (2012), Snipes et al. (2012), and SRI International (2018), suggests that post-intervention school engagement will mediate the relationship between Treatment (i.e., the grit interventions) and GPA change.

8.1 Research Questions 3a – 3g

8.1.1 Method Overview (RQ 3a – 3g)

As outlined in section 5.2, the study that is at the center of this chapter is a cluster-randomized controlled longitudinal field quasi-experiment with mixed-design features. The self-report dependent variables are assessed both before and after the intervention, school marks are tracked across five half-year terms, and other key outcomes are measured exclusively post-intervention. Methods within the framework of analysis of variance (ANOVA) are particularly well suited for this study due to their versatility and robustness in handling various types of data and designs. Repeated-measures ANCOVAs (RM-ANCOVAs) are ideal for analyzing the pretest-posttest self-report measures, as they account for within-subject correlations and provide insights into changes over time. Additionally, they help to isolate the treatment effect by adjusting for the differences among groups, which are unavoidable in random cluster sampling. Univariate and multivariate ANCOVAs are effective for post-only measures, allowing control over multiple baseline variables to ensure that the observed treatment effects are not confounded by pre-existing differences. For longitudinal data, such as grades measured over several time points, RM-ANCOVA effectively handles the temporal aspect of the data, capturing both within-subject and between-subject variations over time. Finally, an ordinal logistic regression model was deemed most appropriate for the two ordinal dependent variables, teachers' evaluations and students' educational attainment, as it accounts for the ordered nature of the categories (e.g., rankings of evaluations and school-leaving certificates) without assuming equal distances between them. Detailed information about measures, participants, and procedures—which apply to all RQs in this chapter—can be found in sections 5.4, 5.5, and 5.6, respectively.

8.1.2 Statistical Analyses and Results (RQ 3a)

For post-intervention self-report measures (Time 2), used in analyses for RQ 3a-c, the Kolmogorov-Smirnov test revealed significant deviations from normality in seven of the 11 variables ($p < .05$), similar to the findings for Time 1 variables. While bootstrapping techniques are employed wherever possible to ensure robust estimates, they are not available for RM-ANCOVA in SPSS, likely due to the complexity of resampling in models that involve correlated within-subjects data. Despite this limitation, ANOVA is generally considered robust to moderate violations of normality, particularly with sufficiently large sample sizes.

Furthermore, including covariates to account for individual differences may mitigate some of the potential effects of non-normality. These considerations justify proceeding with the analyses while acknowledging the deviations from normality as a potential source of bias.

As already reported in Chapter 6, the higher order structure of general grit at T2 was not corroborated using CFA. The first-order factors (grit-PE and grit-CI) did not significantly load onto the higher-order factor (CFA-estimated $b = .247$, $\beta = .240$, $p = .288$), nor were they significantly correlated (CFA-estimated $r = .058$, covariance $p = .578$). For this reason, when looking at the potential change in self-reported general grit from T1 to T2, one can only legitimately work with perseverance and consistency as separate DVs.

The first RM-ANCOVA included Time (T1 and T2 *general perseverance*) as a within-subject factor, Treatment (three experimental groups and one control group) as a between-subject factor, and covariates accounting for initial variability among groups (e.g., school perseverance residual, grit-CI facets, conscientiousness, school belonging, self-efficacy, mindset, and school engagement¹²⁹). Mauchly's Test indicated that sphericity was met across all analyses in this section, so standard F -tests were used throughout. Observed (raw) means and standard deviations (SD s) for general perseverance are offered in Table 8.1 (below).

The main effect of Time was not significant, $F(1, 174) = 0.273$, $p = .602$, partial $\eta^2 = .002$, indicating no overall change in general perseverance across the entire sample from T1 to

Table 8.1

Descriptive Statistics for General Perseverance

	Treatment	M	SD	n
Perseverance (general, T1)	Academic Mindsets (AM)	-.107	1.237	39
	Combined (AM + LSS)	-.079	.986	48
	Learning Skills & Strategies (LSS)	.242	1.053	53
	Control Group (no intervention)	-.060	.956	50
	Total	.010	1.055	190
Perseverance (general, T2)	Academic Mindsets (AM)	.009	1.033	39
	Combined (AM + LSS)	-.089	.708	48
	Learning Skills & Strategies (LSS)	.064	1.028	53
	Control Group (no intervention)	.013	.949	50
	Total	.001	.931	190

¹²⁹ While I hypothesize that school engagement acts as a mediator between the grit interventions and any improvements in academic outcomes (RQ 3d, 3e, 3f, and partly 3c), I do not expect it to play any role in the achievement of self-selected *personal* (i.e., non-academic) goals (RQ 3c) or a potential change in self-reported grit or other psychological variables (RQ 3a, 3b). Therefore, it makes sense to include it as a control variable when attempting to isolate the treatment effect on these specific dependent variables.

T2. The interaction between Time and Treatment was also non-significant, $F(3, 174) = 0.298$, $p = .827$, partial $\eta^2 = .005$, showing that the pattern of change in general perseverance *over time* did not differ significantly among the four groups. Bonferroni-adjusted pairwise comparisons based on estimated marginal means (EMM) and errors revealed that general perseverance did not change significantly from T1 to T2 *within* any of the conditions¹³⁰.

The second RM-ANCOVA included Time (T1 and T2 *general consistency*) as a within-subject factor, and Treatment as a between-subject factor. The school consistency residual, grit-PE facets, and the same set of further variables used in the previous analysis were included as covariates. Table 8.2 (below) presents the raw means and *SDs* for general consistency. Here as well, no significant main effect of Time, $F(1, 174) = 0.533$, $p = .466$, partial $\eta^2 = .003$, or Time * Treatment interaction, $F(3, 174) = 0.661$, $p = .577$, partial $\eta^2 = .011$, was observed, indicating no overall change in general consistency from T1 to T2 and no significant differences in the pattern of change among the groups. Bonferroni-adjusted pairwise comparisons showed no significant within-group changes, despite a slight, non-significant decrease in consistency scores for the AM group. A significant main effect of

Table 8.2

Descriptive Statistics for General Consistency

	Treatment	<i>M</i>	<i>SD</i>	<i>n</i>
Consistency (general, T1)	Academic Mindsets (AM)	-.347	1.050	39
	Combined (AM + LSS)	.006	.777	48
	Learning Skills & Strategies (LSS)	.094	1.085	53
	Control Group (no intervention)	.114	1.006	50
	Total	-.013	.994	190
Consistency (general, T2)	Academic Mindsets (AM)	-.463	.862	39
	Combined (AM + LSS)	-.009	.644	48
	Learning Skills & Strategies (LSS)	.177	.750	53
	Control Group (no intervention)	.208	.787	50
	Total	.007	.795	190

¹³⁰ The Time * Treatment interaction tests whether the pattern of change in the dependent variable (DV) over time differs significantly across groups but does not provide insight into changes **within** specific groups. To understand within-group changes, I examine the group-specific estimated marginal means (EMMs), which provide adjusted estimates of each effect after accounting for the variability attributable to other factors in the statistical model. In contrast, observed (raw) means and errors (such as those in Table 8.1) reflect the combined effects of interactions and main effects and are not suitable for this purpose. All pairwise comparisons in this dissertation are based on EMMs, as these represent the effects net of other variables included in the ANCOVA model. Even if the interaction term is non-significant, EMMs and EMM-based pairwise comparisons are at least examined for group-specific trends. If significant pairwise comparisons are interpreted *in the absence of a significant interaction*, additional justification will be provided, grounded in theoretical considerations and observed patterns in the data. For a discussion of the benefits and drawbacks of using pairwise comparisons to interpret interaction effects, see Garofalo et al. (2022).

Treatment, $F(3, 174) = 4.962, p = .002$, partial $\eta^2 = .079$, indicated differences in consistency scores across groups that were already present at baseline (T1) and remained stable over time.

As opposed to general grit, the higher order structure of school grit at Time 2 was confirmed via CFA (see section 6.5). Therefore, it is legitimate to work with the overall school grit CFA-derived factor score in any subsequent analyses. The third RM-ANCOVA included Time (T1 and T2 *school grit*) as a within-subject factor, and Treatment as a between-subject factor. The overall general grit residual and the known array of additional psychological variables were used as covariates. The raw means and *SDs* for school grit are presented in Table 8.3 (below). Neither Time ($p = .248$) nor the Time * Treatment ($p = .365$) interaction exhibited significant within-subject effects, indicating no overall change in school grit across the entire sample from T1 to T2 and no significant differences among groups in the pattern of change in school grit over time. There was also no significant between-subjects effect of Treatment on school grit scores ($p = .478$). Pairwise comparisons revealed slight, non-significant increases for the combined (COMB) group and control group and decreases for AM and LSS groups, likely reflecting normal variations in self-report scores.

When looking at the separate school grit components as DVs, there was a marginally significant ($p = .054$) within-subject effect of Time for school perseverance, but no indication that different groups developed significantly differently from T1 to T2. For school consistency, there were no significant main or interaction effects at any level of the analysis.

Overall, neither general grit nor school grit, including their respective facets, showed significant changes as a result of any of the interventions. I will explore the potential implications of this finding in the concluding remarks for the entire set of dependent variables

Table 8.3

Descriptive Statistics for overall School Grit

	Treatment	<i>M</i>	<i>SD</i>	<i>n</i>
School grit (T1)	Academic Mindsets (AM)	-.001	.800	38
	Combined (AM + LSS)	-.074	.753	48
	Learning Skills & Strategies (LSS)	.175	.768	54
	Control Group (no intervention)	-.062	.753	50
	Total	.014	.768	190
School grit (T2)	Academic Mindsets (AM)	-.141	.845	38
	Combined (AM + LSS)	-.003	.788	48
	Learning Skills & Strategies (LSS)	.080	.831	54
	Control Group (no intervention)	.047	.868	50
	Total	.006	.830	190

analyzed under Research Questions 3a-g, as well as in section 10.1.8 of the final chapter.

8.1.3 Statistical Analyses and Results (RQ 3b)

RM-ANCOVAs were carried out also for conscientiousness, school belonging, school self-control, school self-efficacy, and fixed / growth mindset, as all of these attributes were touched upon to varying degrees in the grit interventions. In particular, growth mindset and school belonging modules were included in the AM intervention and a self-control module was included in the LSS intervention (and the COMB intervention by extension). Descriptive statistics (raw means and *SDs*) for these variables are found in Appendix F.1 (p. 347).

For conscientiousness, there was a significant Time within-subjects effect ($p = .014$) when considering the entire sample. However, pairwise comparisons show that none of the individual groups improved or worsened significantly from T1 to T2, suggesting that the overall significant effect is driven by small, non-significant changes across multiple groups rather than by substantial changes within any single group. School belonging and school self-efficacy showed no significant main effects, interactions, or within-group changes. Results for school self-control mimic those for conscientiousness, with a significant Time effect ($p = .013$), but no other notable findings, including no significant within-group changes.

For mindset, there was a significant between-subjects effect of Treatment across T1 and T2, $F(3, 175) = 3.917, p = .010$, partial $\eta^2 = .063$, indicating overall differences in mindset scores among the Treatment groups. Pairwise comparisons revealed that the LSS group had significantly higher mindset scores (indicating a fixed mindset) than the COMB condition across time points ($p = .006$). Although the difference between the two groups was only marginally significant at Time 1 ($p = .080$), it became significant at Time 2 ($p = .008$), driven by the COMB group's lower mindset scores post-intervention, which reflect a shift toward a growth mindset in this group. However, no *significant* within-group changes were observed post-intervention in any condition. The absence of change in the self-report mindset measure stands in contrast to the perceived appeal and impact of the growth mindset module in the AM and COMB conditions on students' post-intervention development, a topic explored in detail in section 10.1.5 of the final chapter.

Overall, while significant Time effects were observed for conscientiousness and school self-control and between-group differences emerged for mindset, these findings did not translate into significant changes within individual groups. These results suggest that the grit interventions did not lead to improvements or declines in these self-reported attributes.

8.1.4 Statistical Analyses and Results (RQ 3c)

School engagement, which reflects self-reported academic behaviors like doing

homework and participating in class discussions, is an important dependent variable due to its hypothesized mediating role between the grit interventions and post-intervention academic performance (see RQ 6). Findings from the cross-sectional study at Time 1 have already confirmed it mediates the relationship between school grit and students' GPA (see section 7.5.2), but it may not necessarily mediate the interventions' impact on grades.

The RM-ANCOVA (controlling for all other variables at T1) revealed a significant between-subjects effect of Treatment on engagement across T1 and T2, $F(3, 177) = 2.653, p = .050$, partial $\eta^2 = .043$. No significant Time * Treatment effect was found, $F(3, 177) = 0.652, p = .583$, partial $\eta^2 = .011$, indicating that the pattern of change in school engagement over time did not differ significantly among the groups. Pairwise comparisons showed that the LSS group had marginally higher engagement scores than the COMB group by T2 ($p = .062$), which led to a significant cumulative effect across time points ($p = .033$). In general, engagement levels increased in the AM and LSS conditions and decreased in the COMB and control conditions, but none of these changes were statistically significant. Sensitivity analyses, including models controlling only for demographic variables and models without covariates, confirmed the non-significant Time * Treatment interaction and lack of within-group changes. Descriptive statistics for engagement are provided in Appendix F.2 (p. 349).

While an increase in self-reported engagement post-intervention would have been desirable, none of the intervention modules explicitly addressed academic behaviors or their importance. Only the deliberate practice module in the LSS and COMB conditions emphasized the value of solitary expert practice¹³¹, which applies primarily to schoolwork like exam preparation and homework *outside the classroom*. Thus, this non-result may also suggest that the engagement variable does not capture all relevant behaviors potentially impacted by the interventions, such as learning at home. Nevertheless, post-intervention school engagement (T2) may still mediate the relationship between grit interventions and outcome variables, as hypothesized. Mediation would require a significant Treatment effect on school engagement at T2 (path **a**), a significant relationship between school engagement and GPA across time (path **b**), and either a significant or non-significant direct effect of Treatment on GPA (path **c'**), indicating partial or full mediation, respectively. This possibility will be revisited when discussing mediation analysis results for RQ 6.

8.1.5 Statistical Analyses and Results (RQ 3d)

The achievement of self-selected school and personal goals is unique in two key

¹³¹ i.e., identify a challenge, practice with full dedication and concentration, seek feedback, think, improve, repeat

respects: first, each type of goal is represented by four variables that, although broadly related to the same topic, capture distinct facets of goal achievement, as argued in section 6.4; second, the sample for these variables is considerably smaller than for other DVs, as many students either did not specify self-selected goals at T1 or opted not to respond to goal-completion questions at T2.

Using MAN(C)OVA for analyzing the goal achievement variables is advantageous both theoretically and methodologically, especially with smaller samples. Theoretically, it assesses the treatment's overall impact on the multidimensional construct of goal striving, rather than looking at each aspect in isolation. Methodologically, it reduces Type I error by testing all dependent variables simultaneously and may increase statistical power by accounting for inter-correlations among variables. Including covariates in MANCOVA optimizes the use of available data by controlling for confounders and clarifying treatment effects. However, it is essential to limit the number of covariates to conserve degrees of freedom and avoid overfitting¹³².

In an attempt to streamline the process, I initially conducted the analyses using the *goal importance* variable (DV1) alongside a factor score representing the latent *goal achievement* variable, which encompassed DV2 (goal-directed effort), DV3 (goal progress), and DV4 (goal-achievement confidence)¹³³. However, this approach diluted the distinct effects that each DV might have captured, making the multivariate and between-subject effects harder to interpret. The factor score, which aggregates the variance across DV2, DV3, and DV4, likely masked specific, nuanced intervention impacts by reducing variability in the data. Consequently, I chose to conduct the MAN(C)OVA using the four individual DVs for both school and personal goals.

School Goal Achievement. Unlike in previous analyses, due to the smaller sample available for the *school goal* variables ($n = 174$), I first carried out a MANOVA to establish whether there is any Treatment effect on the DVs without any covariates. Unfortunately, Box's M test indicated that the assumption of equality of covariance matrices was violated ($p = .028$). For this reason, I report Pillai's Trace, which is the most robust multivariate test statistic against violations of the assumption of homogeneity of covariance matrices, and I

¹³² The general recommendation of 10-15 events per variable (EPV) in logistic regression is conceptually similar to observations per predictor in linear regression and other analyses that are rooted in the same mathematical principles, such as AN(C)OVA or MAN(C)OVA.

¹³³ DV1: 'Dieses Ziel ist mir immer noch wichtig' (This goal is still important to me); DV2: 'Wie viel hast du bisher getan, um dieses Ziel zu erreichen?' (How much have you done so far to achieve this goal); DV3: 'Inwieweit hast du dieses Ziel bereits erreicht?' (To what extent have you already achieved this goal?); DV4: 'Falls du derzeit immer noch Mühe und Zeit in dieses Ziel steckst, glaubst du, dass du es noch erreichen kannst?' (If you are currently still working toward this goal, do you think you can still achieve it?).

rely on bootstrapped parameter estimates, rather than parametric post-hoc comparisons. Bootstrapping not only provides more dependable estimates of the treatment effects under these circumstances but also helps address the issue of non-normality in the school goal variables reported in section 6.4.

The MANOVA for the school goal variables revealed a significant overall effect of the Treatment on the combined DVs (Pillai's $V = .130$, $F(12, 513) = 1.933$, $p = .029$, partial $\eta^2 = .043$). The test of between-subject effects showed that the Treatment significantly affected DV3 (school goal progress), $F(3, 172) = 4.429$, $p = .005$, partial $\eta^2 = .072$, but not the other three DVs. The bootstrapped parameter estimates revealed significant effects of the interventions on specific school goal achievement outcomes. Participants in the AM group scored significantly higher on school goal importance compared to the control group ($b = .394$, 95% CI [.022, .751], $p = .043$). Additionally, the LSS group demonstrated significantly greater progress on school goals compared to the control ($b = .477$, 95% CI [.151, .821], $p = .007$), the AM group ($b = .490$, 95% CI [.133, .854], $p = .008$), and the COMB group ($b = 0.546$, 95% CI [.206, .886], $p = .002$). Descriptive statistics for the school goal variables may be found in Appendix F.3 (p. 350).

Due to the cluster-randomized design and lack of guaranteed group equivalence, all preceding analyses included covariates to account for potential group differences. Therefore, to maintain consistency across all DVs, a MANCOVA was carried out next using only demographic variables (cohort, gender, SEA Index) as covariates, serving as a sensitivity analysis to assess whether adjusting for these characteristics altered the treatment effects on school goal variables.

The significant multivariate effect of Treatment on school goal achievement became more pronounced once demographic covariates were included (Pillai's $V = .152$, $F(12, 501) = 2.232$, $p = .010$, partial $\eta^2 = .051$), providing a clearer and more robust picture of the intervention effect. The between-subjects effect of Treatment on school goal progress also increased and was highly significant, $F(3, 168) = 5.903$, $p < .001$, partial $\eta^2 = .095$. Bootstrapped parameter estimates revealed lower p -values for the effect of the AM intervention on DV1 compared to the control group ($p = .037$) and for the effect of the LSS intervention on DV3 ($p = .003$ compared to the AM group, $p < .001$ compared to the COMB group, and $p = .002$ compared to the control), indicating stronger and more significant intervention effects when accounting for demographic factors.

While none of the covariates had a significant multivariate effect, specific covariates did show significant between-subjects effects on individual DVs. Cohort had a significant

positive effect on DV3 (goal progress, $p = .040$), indicating that Grade 9 students reported achieving their school goals to a greater extent than Grade 8 students. Additionally, SEA had a significant positive effect on both DV3 ($p = .021$) and DV4 (goal-achievement confidence, $p = .008$), indicating that socio-educationally advantaged students made more progress on school goals and had greater confidence in achieving them compared to their peers.

In the final step of the MANCOVA analysis, all theoretically relevant covariates were included. Covariates with high multivariate p -values (above 0.2) and no significant or marginal effects on any dependent variable—i.e., gender, school belonging, school self-control, and school engagement—were subsequently removed to preserve degrees of freedom and improve robustness and interpretability, especially given the smaller sample size. This decision aligns with the principle of parsimony (Occam's razor), which suggests that simpler models are preferable when they explain the data just as well as more complex ones.

The final model, which included cohort, SEA, school grit, conscientiousness, school self-efficacy, and mindset as covariates¹³⁴, largely replicated the results of the analysis with only demographic covariates. While the multivariate effect of Treatment became less significant (Pillai's V , $p = .053$, partial $\eta^2 = .041$)¹³⁵, the between-subjects effect of Treatment on DV3 (school goal progress) remained significant ($p = .009$, partial $\eta^2 = .068$). Bootstrapped parameter estimates confirmed that the LSS group scored significantly higher than all other groups on school goal progress, but the effect of the AM intervention on school goal importance was only marginally significant ($p = .059$). Two covariates—school grit and school self-efficacy—had a significant positive multivariate effect (Pillai's V , $p < .001$ and $p = .017$, respectively), while mindset had a marginally significant negative multivariate effect (Pillai's V , $p = .053$), the latter two driven by their significant association with DV4 (goal achievement confidence). Baseline school grit, in particular, emerged as the strongest predictor of school goal-directed effort ($p < .001$) and school goal progress ($p < .001$), surpassing the impact of the interventions. The negative effect of mindset on goal-achievement confidence ($p = .012$) aligns with the theory that having a growth mindset is associated with greater confidence in one's ability to achieve a goal.

Personal Goal Achievement. For the four *personal goal variables*, which had the smallest sample size among all dependent variables in this dataset ($n = 118$), I also began by conducting a MANOVA to assess any potential Treatment effects before adjusting for covariates. However, this model did not meet the assumptions of equal error variances (for

¹³⁴ On average, there were 19.33 observations per predictor in this model, which is considered adequate.

¹³⁵ Wilks' Lambda, $p = .051$, Hotelling's Trace, $p = .050$, Roy's Largest Root, $p = .004$

three out of four DVs) or equal covariance matrices. As a result, I relied on Pillai's statistic and bootstrapped estimates in this analysis as well, particularly since bootstrapping also improves the reliability of estimates given the non-normal distribution of the personal goal variables reported in section 6.4.

The multivariate effect of Treatment on personal goal achievement was significant only at the .10 level, Pillai's $V = .159$, $F(12, 339) = 1.577$, $p = .096$, partial $\eta^2 = .053$. However, the between-subjects effect of Treatment on DV3 (personal goal progress), was significant at the .05 level: $F(3, 114) = 3.879$, $p = .011$, partial $\eta^2 = .093$. The bootstrapped parameter estimates for personal goal progress revealed that the LSS group scored significantly higher than the AM group ($b = .719$, 95% CI [0.109, 1.200], $p = .017$) and the COMB group ($b = .757$, 95% CI [0.265, 1.250], $p = .007$), and marginally higher than the control group ($b = .374$, 95% CI [-0.006, 0.754], $p = .052$). No significant or marginally significant differences were observed for the other DVs. These findings emphasize the stronger association between the LSS condition and personal goal progress. Appendix F.4 (p. 351) provides descriptive statistics for the personal goal variables.

The multivariate Treatment effect became stronger after including demographic covariates (Pillai's V , $p = .068$, partial $\eta^2 = .058$), while the between-subjects effect on personal goal progress remained significant but slightly weaker ($p = .030$, partial $\eta^2 = .078$). Bootstrapped parameter estimates corroborated the MANOVA findings, confirming the significant positive effect of the LSS intervention on personal goal progress, though with slightly higher p -values. Gender had a marginally significant, positive between-subjects effect on DV1 (personal goal importance) ($p = .054$, with a significant bootstrapped parameter estimate of $b = .458$, 95% CI [.017, .897], $p = .045$), indicating that female students scored higher on this variable than male students across groups. The SEA Index had a significant, positive between-subjects effect on goal-achievement confidence ($p = .002$, partial $\eta^2 = .086$; bootstrapped parameter estimate $b = .476$, 95% CI [.161, .757], $p = .002$), showing that socio-educationally advantaged students had more confidence in their ability to achieve their goals.

In the final step of the MANCOVA analysis, all remaining covariates that could potentially influence personal goal achievement were included. Those with high multivariate p -values (> 0.3) and no significant or marginal effects on any individual DV—i.e., cohort, general grit, conscientiousness, school self-control, school self-efficacy, mindset, and school engagement—were deemed to have minimal impact on the variance in the DVs and were therefore excluded.

The final model, which included gender, SEA Index, school grit, and school belonging

as covariates¹³⁶, largely replicated the results of the analysis with only demographic covariates, though the multivariate effect of Treatment became less significant (Pillai's V , $p = .080$, partial $\eta^2 = .057$)¹³⁷. The between-subjects effect of Treatment on DV3 (personal goal progress) remained significant, $p = .030$, partial $\eta^2 = .079$. The LSS group scored significantly higher than the AM group ($p = .030$) and the COMB group ($p = .010$) and marginally higher than the control group ($p = .058$) on personal goal progress. SEA had a significant multivariate effect on personal goal achievement (Pillai's V , $p = .040$, partial $\eta^2 = .089$). The between-subject effects revealed that SEA and school belonging were significantly associated with goal-achievement confidence ($p = .004$ and $p = .020$, respectively). These findings suggest that the school environment may shape the relevance and expression of domain-general traits, such as general grit and conscientiousness—excluded from the final model due to their limited explanatory power—making school-related factors like school grit and school belonging more salient in the pursuit of personal goals.

The analysis focused on *personal goal achievement* highlighted the positive association between the LSS intervention and personal goal progress. While the LSS group outperformed the other experimental groups, its advantage over the control group was only marginal, suggesting that the intervention effect may be modest and sensitive to analytical methods. The small sample size ($n = 118$) likely limited the statistical power of the analysis, contributing to these results.

Conclusion. In summary, despite challenges related to data quality and reduced participant numbers, the findings emphasize the nuanced and multifaceted impact of targeted grit interventions on school and personal goal achievement. The LSS intervention demonstrated a consistent positive impact on goal progress, especially in the school context, while the AM intervention was positively associated with maintaining school goal importance. The goal-setting content in the LSS intervention, particularly the use of MCII, aligns with the significant progress students in this group made on their self-selected goals. Similarly, the AM intervention, which emphasized values-concordant goals, likely contributed to the sustained interest in school goals observed in this group. However, the lack of comparable progress in the COMB intervention group, which also included these contents, suggests that integrating multiple interventions may—contrary to expectations—dilute the impact of individual components, reducing their effectiveness. These results could also be due to cognitive overload, which may have interfered with the successful implementation of the

¹³⁶ On average, there were 16.71 observations per predictor in this model, which is considered adequate.

¹³⁷ Wilks' Lambda, $p = .072$, Hotelling's Trace, $p = .066$, Roy's Largest Root, $p = .003$

goal-setting and value-alignment strategies.

Covariate effects revealed that SEA was consistently associated with greater progress and confidence in achieving both school and personal goals. Additionally, female students reported higher personal goal importance, and older students (Grade 9) achieved greater school goal progress compared to their peers. School self-efficacy, school belonging, and a growth mindset were all positively associated with goal achievement confidence. Importantly, baseline school grit emerged as a strong predictor of goal-directed effort and goal progress across all groups, highlighting its pivotal role in school goal achievement. However, grit did not moderate the relationship between interventions and outcomes, indicating that Treatment effects on goal achievement were not contingent on school grit levels.

8.1.6 Statistical Analyses and Results (RQ 3e)

The next set of analyses incorporated students' half-year GPA at T2 and T5, which had not been used in prior analyses. An inspection of the distribution of these variables shows that they meet the assumption of normality, as confirmed by Kolmogorov-Smirnov tests.

Analysis of Academic Outcomes across Two Time Points. In order to gauge the effects of the grit interventions on students' academic performance, two RM-ANCOVAs were carried out. The first analysis included Time (pre and post-intervention GPA) as a within-subject factor with two levels, Treatment as a between-subject factor with four levels, and a set of covariates. The raw means and *SDs* for students' GPA are offered in Table 8.4 (p. 183).

The covariates included variables measured at T1 that account for the initial variability between groups and are likely to predict grades (see section 7.2.2), namely cohort, gender, SEA Index, school grit, conscientiousness, school belonging, school self-control, school self-efficacy, and mindset¹³⁸. To ensure that these covariates are indeed confounders and not moderators, I first included each of them separately in the RM-ANOVA and tested for interactions with Time, Treatment, and Time * Treatment. This approach confirmed that the assumption of homogeneity of regression slopes was met.

The main effect of Time was non-significant ($p = .658$, partial $\eta^2 = .001$), indicating no consistent overall change in GPA across the entire sample¹³⁹. The primary focus of the RM-ANCOVA was the interaction between Time and Treatment to determine the impact of

¹³⁸ As in the analyses for RQ 2a, school engagement was intentionally excluded from the RM-ANCOVA for RQ 3e, based on the assumption that it might mediate the relationship between the grit interventions and students' GPA. If school engagement were indeed a mediator, including it in the analysis would likely reduce the observed relationship between the interventions and grades, potentially undermining the effort to accurately assess the interventions' effects. Consequently, the results of the mediation analysis involving school engagement are presented in the findings section for RQ 6 below.

¹³⁹ However, Bonferroni-adjusted pairwise comparisons of the EMMs revealed a small but significant increase from Time 1 to Time 2 across all groups ($M_{\text{diff}} = 0.047$, $SE = .018$, 95% CI [.011, .083], $p = .011$).

Table 8.4*Descriptive Statistics for Students' GPA (T1, T2)*

	Treatment	<i>M</i>	<i>SD</i>	<i>n</i>
GPA (T1)	Academic Mindsets (AM)	-.062	.803	34
	Combined (AM + LSS)	-.163	.906	47
	Learning Skills & Strategies (LSS)	.185	.900	57
	Control Group (no intervention)	-.003	.739	47
	Total	.003	.850	185
GPA (T2)	Academic Mindsets (AM)	-.125	.823	34
	Combined (AM + LSS)	-.035	.849	47
	Learning Skills & Strategies (LSS)	.251	.893	57
	Control Group (no intervention)	.056	.752	47
	Total	.059	.840	185

different treatments on academic performance. This interaction was significant, $F(3, 172) = 4.201, p = .007$, partial $\eta^2 = .068$, indicating a moderate effect size for the differential change in GPA across treatment groups. Multivariate analyses showed significant Time effects within the COMB group, $F(1, 172) = 11.892, p < .001$, partial $\eta^2 = .065$ (a medium effect), and the LSS group, $F(1, 172) = 4.557, p = .034$, partial $\eta^2 = .026$ (a small effect). In contrast, the AM and control groups did not show significant Time effects ($p > .05$). Bonferroni-adjusted pairwise comparisons confirmed these findings, with a significant increase in students' GPA from Time 1 to Time 2 within the LSS group ($M_{\text{diff}} = 0.072, SE = 0.034, 95\% \text{ CI } [.005, .138], p = .034$) and an even more pronounced increase in the COMB group ($M_{\text{diff}} = 0.124, SE = 0.036, 95\% \text{ CI } [.053, .195], p < .001$). Table 8.5 (p. 184) presents significant pairwise comparisons and multivariate tests for the Treatment * Time interaction.

The main effect of Treatment as a between-subjects factor was not significant, $F(3, 172) = 2.038, p = .110$, partial $\eta^2 = .034$, indicating no significant differences in grades between groups when averaging across T1 and T2. This result is desirable, as it suggests that the groups were comparable at baseline, allowing for a more meaningful interpretation of any changes over time attributable to the interventions. Most covariates demonstrated significant between-subjects effects, including SEA, mindset, gender, conscientiousness, school self-efficacy, and school grit. These associations were, as anticipated, positive for SEA, gender¹⁴⁰, school self-efficacy, and school grit. Mirroring the results of the regression analyses in section (RQ 2a), higher conscientiousness was negatively associated with school performance at both T1 and T2. While conscientiousness is typically linked to positive academic outcomes, it

¹⁴⁰ Female students earned significantly better grades than male students across time points and groups.

Table 8.5

*Significant Pairwise Comparisons and Multivariate Tests for the Treatment * Time Interaction (T1 to T2)*

Group	Mean Diff. ^a	SE	p ^b	95% CI		Multiv. Test	V	F	H. df	E. df	p η^2
				LL	UL						
LSS	.072	.034	.034	.005	.138	Pillai's Trace	.026	4.557	1	172	.026
COMB	.124	.036	< .001	.053	.195	Pillai's Trace	.065	11.892	1	172	.065

Note. LSS = Learning Skills and Strategies group; COMB = combined intervention group (AM + LSS); Mean Diff. = Mean difference; H. df = Hypothesis degrees of freedom; E. df = Error degrees of freedom.

^a Time 2 - Time 1

^b Adjustment for multiple comparisons: Bonferroni.

is possible that in this sample, high levels of conscientiousness may be associated with perfectionism or stress, which could negatively affect academic performance. In contrast, the significant negative association between a fixed mindset and grades aligns with existing theories and reinforces the importance of fostering a growth mindset in educational settings. The covariates' significant impact on GPA underscores their role as confounders. Controlling for them strengthens the validity of the findings as the observed changes in GPA are more likely attributable to the interventions themselves, rather than to extraneous factors. Table 8.6 (p. 185) presents selected within-subjects and between-subjects effects for this analysis.

To quantify the relative improvement of each experimental group compared to the control group, the model-based *quotient effect size* (q) was used¹⁴¹. q is a simple, dimensionless measure defined as the ratio of the adjusted gain score (post-intervention minus pre-intervention) in the experimental group to the adjusted gain score in the control group. Unlike Cohen's d_s ¹⁴², which standardizes changes using the pooled standard deviation and can therefore be influenced by variability unrelated to the intervention, q achieves scale independence without involving the standard deviation, making it a straightforward and intuitive measure of relative effect (Foster, 2023). In this study, a q of 2.000 for the COMB group indicates that its improvement was twice as large as that of the control group, while a q of 1.161 for the LSS group reflects a 16.1% greater improvement relative to the control.

For comparison, the between-group d_s effect sizes, representing the net intervention effects as standardized mean differences between each experimental group and the control group, were calculated using model-based EMMs and raw pooled standard deviations without

¹⁴¹ Model-based refers to the use of estimated marginal means (EMMs) to compare changes in the experimental groups against changes in the control group, accounting for the covariates included in the model.

¹⁴² Cohen's d is a family of effect size measures. It is good practice to use subscripts to differentiate between different versions of Cohen's d . In this case, the subscript s indicates that the **pooled standard deviation (SD)** is used as the standardizer (Lakens, 2013).

Table 8.6*Selected Within-Subjects and Between-Subjects Effects on GPA (T1 to T2)*

Effect	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>	<i>pη</i> ²
Within-subjects					
Time	0.197	1	172	.658	.001
Time * Treatment	4.201	3	172	.007	.068
Time * School grit	5.321	1	172	.022	.030
Between-subjects					
Treatment	2.038	3	172	.110	.034
Gender	9.287	1	172	.003	.051
SEA Index	23.247	1	172	< .001	.119
School grit	4.489	1	172	.036	.025
Conscientiousness	5.663	1	172	.018	.032
School self-efficacy	4.828	1	172	.029	.027
Mindset	10.606	1	172	.001	.058

accounting for within-subject correlations¹⁴³. These values were -0.172 (AM), 0.076 (COMB), and 0.013 (LSS). Based on Kraft's (2020) benchmarks for interpreting effect sizes in education interventions—expressed in *SD* units and conceptually equivalent to Cohen's *d*¹⁴⁴ (small: < 0.05; medium: 0.05 to < 0.20; large: ≥ 0.20)—the COMB group's effect size falls within the medium range, the LSS group's effect size is small, and the AM group's *d_s* represents a moderate negative effect relative to the control¹⁴⁵. While these metrics are less intuitive than *q* values, they provide a complementary perspective by reflecting the absolute standardized differences between groups.

These results indicate that the COMB condition showed the largest improvement both within-group and relative to the control group, while the LSS group demonstrated a small but statistically significant improvement. The lack of significant change in the AM and control groups suggests that the academic mindsets content alone may not be sufficient to produce

¹⁴³ The formula was $d_s = \frac{\text{Mean change experimental} - \text{Mean change control}}{\text{Pooled } SD}$, where $SD_{\text{pooled}} = \sqrt{\frac{(n_{\text{exp}} - 1)SD_{\text{exp}}^2 + (n_{\text{control}} - 1)SD_{\text{control}}^2}{n_{\text{exp}} + n_{\text{control}} - 2}}$

Here, n_{exp} and n_{control} are the sample sizes of the experimental and control groups, and SD_{exp} and SD_{control} are their respective standard deviations. The pooled *SD* is a weighted average of the two *SD*s, adjusted for sample size.

¹⁴⁴ Both metrics quantify the standardized mean difference between groups, making them comparable measures of effect size. Yet, when *SD* refers to an improvement within a single group, the two are not interchangeable.

¹⁴⁵ It is important to note that Kraft's benchmarks are derived from nearly 750 randomized control trials (RCTs) evaluating interventions with *standardized test outcomes*. At the same time, an older meta-analysis by Durlak et al. (2011) found an overall mean effect of universal school-based social-emotional development programs on GPA / grades to be $g = .33$, compared to which the effect of the COMB intervention would be considered small, not medium. For further discussion on effect sizes in education interventions, see Yeager et al. (2019), who note that the median effect size for 'promising' U.S. government-funded interventions in schools was just 0.03 *SD*.

measurable GPA improvements within the period studied. In contrast, the LSS intervention, particularly when combined with AM, was effective in improving grades. These findings underscore the importance of integrating practical skills development with mindset training to achieve the most substantial academic benefits.

Extended Analysis across Three Time Points. To examine the long-term impact of the grit interventions on students' GPA development, I conducted a RM-ANOVA using all five time points and no covariates as a preliminary step. The results indicated that significant changes occurred within groups only between T1 and T2 and between T2 and T5, whereas T3 and T4 were just points along a relatively flat linear development between T2 and T5, adding little information to the overall pattern. Given that controlling for confounders in the analysis with five time points would result in a severely over-parameterized model relative to the sample size ($n = 176$), I decided to focus on three key time points: T1, T2, and T5. This selection captures the full development of grades over a 2.5-year period while also allowing the inclusion of the same covariates as in the two-time-point model, which ensures comparability between these analyses¹⁴⁶. Table 8.7 (p. 187) includes the raw means and *SDs* for students' GPA over three time points.

The RM-ANCOVA results were interpreted using Pillai's Trace due to a significant Box's *M* test ($p = .028$) and Greenhouse-Geisser corrections due to a significant Mauchly's test ($p < .001$), indicating violations of the assumptions of equality of covariance matrices and sphericity.

The multivariate test results revealed, once again, a significant interaction between Time and Treatment (Pillai's $V = .110$, $F(6, 326) = 3.162$, $p = .005$, partial $\eta^2 = .055$), indicating that changes in GPA over time varied significantly across the four conditions. Similarly, the significant within-subjects effects ($F(6, 326) = 2.471$, $p = .040$, partial $\eta^2 = .044$) and a highly significant quadratic contrast ($F(3, 163) = 5.958$, $p < .001$, partial $\eta^2 = .099$) revealed a non-linear trend in grade changes, with different patterns of change depending on the group.

Multivariate tests within each treatment group further supported these observations. The AM group showed a significant GPA change *over the entire study period* (Pillai's $V = .067$, $F(2, 162) = 5.796$, $p = .004$, partial $\eta^2 = .067$). Similarly, the COMB group exhibited a significant time effect (Pillai's $V = .046$, $F(2, 162) = 3.864$, $p = .023$, partial $\eta^2 = .046$), while the positive change in the LSS group no longer reached statistical significance ($p = .111$).

¹⁴⁶ The resulting participant-to-parameter ratio of 8.8 observations per predictor is slightly lower than the generally recommended 10:1 ratio.

Table 8.7*Descriptive Statistics for Students' GPA (T1, T2, T5)*

	Treatment	<i>M</i>	<i>SD</i>	<i>n</i>
GPA (T1)	Academic Mindsets (AM)	-.082	.807	33
	Combined (AM + LSS)	-.056	.820	42
	Learning Skills & Strategies (LSS)	.190	.919	54
	Control Group (no intervention)	-.003	.739	47
	Total	.028	.830	176
GPA (T2)	Academic Mindsets (AM)	-.145	.827	33
	Combined (AM + LSS)	.047	.779	42
	Learning Skills & Strategies (LSS)	.249	.910	54
	Control Group (no intervention)	.056	.752	47
	Total	.075	.828	176
GPA (T5)	Academic Mindsets (AM)	.069	.942	33
	Combined (AM + LSS)	.030	.751	42
	Learning Skills & Strategies (LSS)	.202	.921	54
	Control Group (no intervention)	.009	.657	47
	Total	.085	.819	176

Bonferroni-adjusted pairwise comparisons further highlighted significant within-group changes in grades *between specific time points*. In the AM group, there was a significant increase in grades from T2 to T5 ($M_{\text{diff}} = 0.232$, $SE = 0.073$, 95% CI [.055, .409], $p = .006$). In the COMB group, grades increased significantly from T1 to T2 ($M_{\text{diff}} = 0.105$, $SE = 0.038$, 95% CI [.014, .196], $p = .018$), consistent with the results of the analysis with only two time points. However, the previously significant increase in grades in the LSS group from T1 to T2 ($p = .034$) was no longer statistically significant when a third time point (T5) was included ($p = .167$). This change may be due to the exclusion of nine students who lacked grades at T5, potentially affecting the significance of the LSS group's progress from T1 to T2. Additional factors, such as variability introduced by the third time point and the overall trend across all time points, may have diluted the T1-to-T2 effect. Though the current non-significant result for LSS does not negate the positive change observed from T1 to T2, it suggests the initial improvement may not have been sustained, stressing the importance of examining multiple time points to assess the long-term impact of interventions. Table 8.8 (p. 188) shows significant pairwise comparisons and multivariate tests for the Treatment * Time interaction.

Significant covariate effects included interactions for Time * school grit ($p = .033$) and Time * conscientiousness ($p = .040$), as well as between-subject effects for gender ($p = .003$), SEA ($p < .001$), school self-efficacy ($p = .008$), and mindset ($p = .002$), indicating that these

Table 8.8*Significant Pairwise Comparisons and Multivariate Tests for the Treatment * Time Interaction (T1 to T5)*

Group	Mean Diff.	SE	p^c	95% CI		Multiv. Test	V	F	H. df	E. df	$p\eta^2$
				LL	UL						
AM	.232 ^a	.073	.006	.055	.409	Pillai's Trace	.067	5.796	2	162	.067
COMB	.105 ^b	.038	.018	.014	.196	Pillai's Trace	.046	3.864	2	162	.046

Note. AM = Academic Mindsets group; COMB = combined intervention group (AM + LSS); Mean Diff. = Mean difference; H. df = Hypothesis degrees of freedom; E. df = Error degrees of freedom.

^a Time 5 - Time 2

^b Time 2 - Time 1

^c Adjustment for multiple comparisons: Bonferroni.

covariates explain a substantial portion of the variance in students' GPA across conditions and time points and highlighting the importance of controlling for individual differences in longitudinal analyses. Table 8.9 (p. 189) shows selected within- and between-subjects effects.

Due to the very small improvement observed in the control group from T1 to T5 ($M_{diff} = .015$), the q effect sizes indicate that the AM group improved nearly 11 times as much as the control group over the duration of the study, while the COMB group improved over six times as much as the control. In contrast, the LSS group's improvement was only 13.3% of the control group's improvement, indicating a negligible effect. While these proportional differences may appear substantial, they often represent relatively small changes in GPA. For example, if an average student in the control group improved from a GPA of 3.00 to 3.05, an average student in the AM group would improve from 3.00 to 3.53 over the same timeframe.

For comparison, the between-group d_s effect sizes, representing the net intervention effects for each experimental group compared to the control group from T1 to T5, are $d_s = 0.200$ for the AM group, indicating a large intervention effect according to Kraft's (2020) benchmarks, $d_s = 0.118$ for the COMB group, reflecting a medium effect, and $d_s = -0.017$ for the LSS group, suggesting no meaningful difference compared to the control group by the end of the study¹⁴⁷. These values highlight the varying impact of the interventions, with the AM group showing the most substantial improvement after Time 2.

To examine potential *moderation effects of covariates* on the relationship between Treatment and grades (important for RQ 5), I conducted an exploratory analysis that included all main effects and interaction terms between Treatment and each covariate. While this model was too complex for the sample size and intended purely for exploratory purposes, it

¹⁴⁷ It is important to reiterate that Kraft's benchmarks were based on standardized test scores, meaning they can only serve as a rough guide for interpreting effects on school grades. Nevertheless, it is reasonable to assume that, for example, a $d_s = 0.3$ would represent a large effect for school grades, just as it does for test scores.

Table 8.9*Selected Within-Subjects and Between-Subjects Effects on GPA (T1 to T5)*

Effect	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>	<i>pη^2</i>
Within-subjects					
Time	0.581	1.456	237.309	.507	.004
Time * Treatment	2.471	4.368	237.309	.040	.044
Time * Conscientiousness	3.670	1.456	237.309	.040	.022
Time * School grit	3.284	1.456	237.309	.054	.020
Time * SEA Index	3.136	1.456	237.309	.061	.019
Time * Gender	2.973	1.456	237.309	.069	.018
Between-subjects					
Treatment	1.220	3	163	.304	.022
Gender	9.392	1	163	.003	.054
SEA Index	18.944	1	163	< .001	.104
School self-efficacy	7.278	1	163	.008	.043
Mindset	10.336	1	163	.002	.060

Note. The Greenhouse-Geisser correction was applied to the within-subjects effects.

revealed that demographic variables (cohort, gender, and SEA Index) were the most likely moderators, with several quadratic and linear contrasts for Time * Treatment * Covariate interactions being significant or marginally significant. This is theoretically plausible, as demographic factors are more likely to influence the interventions' impact on grades over time compared to pre-intervention self-report measures. Although I did not investigate these interactions in detail, they indicate that the interventions interact with students' personal characteristics in complex ways that warrant further exploration. It is plausible that the interventions might be more effective for certain demographic groups, a hypothesis that will be tested in section 8.4.2 focusing on RQ 5.

Taken together, the findings from this 2.5-year longitudinal analysis suggest that the AM intervention had a delayed effect, with a non-significant drop in performance from T1 to T2 followed by significant improvement from T2 to T5. This indicates that mindset training alone may require more time to yield measurable benefits. In contrast, the COMB intervention, and to a lesser extent the LSS intervention, demonstrated significant short-term impacts on GPA (sustained only in the COMB group), highlighting varying timescales over which different types of interventions may affect academic performance.

The control group showed no significant improvement at any time point, supporting the conclusion that the observed gains in intervention groups are attributable to the specific treatments rather than developmental trends or external factors. Overall, the results confirm

the hypothesis that students in the treatment groups would improve more on measures of academic performance than those in the control group.

8.1.7 Statistical Analyses and Results (RQ 3f)

Given the ordinal nature of the dependent variable (teachers' end-of-the-year evaluations, where students were rated from 1 = 'a lot worse' to 5 = 'a lot better' compared to the previous term, recoded into three categories 1 = worse, 2 = same, 3 = better), a generalized linear model (GLM) with an ordinal logistic regression link function was used to examine the effect of Treatment on teacher evaluations (T2), controlling for several covariates. In the process of model refinement, covariates with very high p -values ($p > .70$) were removed to simplify the model and reduce the risk of overfitting. The final model, containing 12 parameters for a sample size of 183 students, included general grit-CI, conscientiousness, school belonging, and mindset.

Additionally, GPA at T1 was included as a covariate to control for baseline academic performance. Pre-intervention grades serve as a proxy for students' initial performance, providing context for the period being evaluated and capturing more variance in the T2 evaluations. By accounting for prior academic achievement, which is likely to be highly relevant to T2 outcomes, the model becomes more robust, enabling a clearer understanding of how the grit interventions influence changes in student performance from T1 to T2.

The model's overall fit was assessed using the Omnibus test and goodness-of-fit statistics. The Likelihood Ratio Chi-Square for the model was significant, $\chi^2(9) = 19.596$, $p = .021$, indicating that the full model provided a significantly better fit than the null model (i.e., a model with only the intercept). The Deviance/df ratio of 0.916 indicates no over- or underdispersion in the data, while the Pearson Chi-Square/df ratio of 1.002 suggests a well-fitting model.

Tests of Model Effects revealed that Treatment did not reach statistical significance in the final model ($\chi^2(3) = 5.087$, $p = .166$), indicating no significant differences in teacher evaluations across treatment groups. However, general grit-CI was significant (Wald $\chi^2(1) = 5.030$, $p = .025$), as was GPA at T1 (Wald $\chi^2(1) = 5.281$, $p = .022$), suggesting that both consistency of interests and prior academic performance were important predictors of teachers' evaluations. Paradoxically, higher levels of consistency were associated with lower teacher evaluations at T2. This finding could reflect the fact that teachers have higher expectations for gritty students, leading to more critical evaluations when their performance doesn't meet or exceed those expectations. Moreover, as pre-intervention grit is a strong predictor of grades at T1 (see sections 7.2.2 and 7.3.2), students with higher grit scores may

have already been performing at or near their potential during the first term (pre-intervention). Consequently, they may have less room for improvement (known as a ‘ceiling effect’), leading to smaller observable gains in performance between T1 and T2. Alternatively, but less likely, gritty students may have maintained effort using strategies that did not result in substantial performance gains, leading to perceived plateauing in their progress.

A closer look at the recoded teacher evaluation (T2) variable, which grouped students into three categories (worse, same, and better), reveals that 128 out of the 205 students (62.4%) were rated as having stayed the ‘same’ (see Table 8.10, below). Only 77 evaluations reflected either improvements (36 students) or declines (41 students), meaning that the data available for assessing meaningful differences was limited. Descriptive comparisons of the frequencies indicate that the combined intervention group had the highest percentage of students rated as ‘better’ (23.1%) and the lowest percentage rated as ‘worse’ (17.3%), suggesting that this group was evaluated more favorably by teachers. However, while these differences are apparent in the raw percentages, they were not statistically significant. Bonferroni-adjusted post hoc comparisons from the crosstabulation, which—unlike the ordinal logistic regression—did not account for potential confounders, revealed no significant differences between the groups. This outcome may be attributed to the small sample sizes within each category and the large share of students who were rated as having stagnated, potentially limiting the power to detect significant differences.

These results, alongside earlier analyses showing significant grade improvements for students in the treatment groups compared to the control group, suggest that while the interventions may have positively impacted academic performance, these gains were not fully mirrored in teacher evaluations. These evaluations likely encompass longer-term perceptions

Table 8.10

*Teacher Evaluation T2 * Treatment Crosstabulation*

		Treatment								Total	
		AM		COMB		LSS		CG		n	%
		n	%	n	%	n	%	n	%		
Teacher Evaluation	Worse	7 _a	17.9%	9 _a	17.3%	15 _a	25.0%	10 _a	18.5%	41	20.0%
	Same	25 _a	64.1%	31 _a	59.6%	37 _a	61.7%	35 _a	64.8%	128	62.4%
	Better	7 _a	17.9%	12 _a	23.1%	8 _a	13.3%	9 _a	16.7%	36	17.6%
Total		39	100.0%	52	100.0%	60	100.0%	54	100.0%	205	100.0%

Note. AM = Academic Mindsets group, COMB = Combined intervention group, LSS = Learning Skills & Strategies group, CG = Control group

_a Each subscript letter denotes a subset of Treatment categories whose column proportions do not differ significantly from each other at the .05 level (Bonferroni adjustment).

of effort, consistency, in-class behavior, and other factors beyond immediate improvements in performance. As such, it is plausible that the short-term benefits of the interventions had not yet translated into more positive teacher evaluations two to three months post-intervention.

8.1.8 Statistical Analyses and Results (RQ 3g)

Given the ordinal nature of the DV (school-leaving certificates, with 0 = ‘no certificate’ and 5 = ‘Abitur (expected)’¹⁴⁸, recoded into three categories, 1 = LLC, 2 = MLC, 3 = ULC¹⁴⁹), a generalized linear model (GLM) with an ordinal logistic regression link function was employed to examine the effect of Treatment on educational attainment five years post-intervention. GPA at T1 (pre-intervention) and T5 (last available time point) were included as covariates to control for baseline and final academic standing. Aside from GPA, only covariates that explained additional variance in the DV and did not worsen model fit indices—i.e., cohort, school self-control, and mindset—were kept in the final model to maintain parsimony and avoid overfitting¹⁵⁰.

The model exhibited an adequate fit, reflected by a Deviance/df ratio of 0.294, which suggests some level of underdispersion, and a Pearson Chi-Square/df ratio of 0.677, indicating reasonable fit. The Likelihood Ratio Chi-Square test was highly significant, $\chi^2(8) = 215.390$, $p < .001$, confirming that the full model significantly improved fit relative to the null model.

Tests of Model Effects revealed that Treatment group significantly predicted school-leaving certificates, Wald $\chi^2(3) = 12.983$, $p = .005$. Parameter estimates indicated that students in the AM group were significantly less likely to obtain higher-level school-leaving certificates compared to the control group ($b = -2.516$, $SE = 0.816$, Wald $\chi^2(1) = 9.517$, $p = .002$). While the LSS and COMB groups outperformed the control group (positive b values), these differences were not statistically significant ($p > .05$). Both T1 and T5 grades were highly significant predictors of certificates. Final GPA exerted the strongest influence (Wald $\chi^2(1) = 30.509$, $p < .001$, $b = 5.760$, $SE = 1.042$), with higher GPA strongly associated with earning higher-level certificates. GPA at T1 also contributed significantly (Wald $\chi^2(1) = 9.984$, $p = .002$, $b = 2.127$, $SE = 0.673$), confirming that initial academic standing had a lasting effect on educational attainment.

To explore the relationship between Treatment and school-leaving certificates in more

¹⁴⁸ The certificates are ranked from lower-level to higher-level, as follows: 0 = no certificate, 1 = EinfBBR, 2 = ErwBBR, 3 = MSA, 4 = Fachabitur, 5 = Abitur (expected). A concise overview of the characteristics for each type of school-leaving certificate may be found at the following link (in German): <https://www.bo-web-bremen.de/abschluss/>

¹⁴⁹ LLC = Low-level certificates (no certificate, EinfBBR, ErwBBR), MLC = Middle-level certificates (MSA), ULC = Upper-level certificates (Fachabitur, Abitur)

¹⁵⁰ The observations per predictor ratio for the final model was $175 / 11 = 15.9$.

depth, and in particular the seemingly negative effect of the AM intervention, a crosstabulation analysis was conducted (Table 8.11, p. 194). While the Pearson Chi-Square test was only marginally significant ($\chi^2(6) = 11.611, p = .071$), other ordinal association measures, including Somers' d and Spearman's R , indicated a small but statistically significant relationship between Treatment and school-leaving certificates. The LSS group had the highest proportion of upper-level certificates (ULC), while the AM group had the highest proportion of lower-level certificates (LLC), consistent with earlier findings that the LSS group outperformed the AM group academically. However, Bonferroni-corrected post hoc comparisons—which do not control for GPA or other covariates—did not confirm these differences as statistically significant.

Earlier preparatory repeated measures analyses of students' GPA across multiple time points—conducted prior to the final analyses for RQ 3e (see p. 186)—indicated that students in the AM group had lower GPA than those in the other three conditions across all time points except T5, and the difference between the AM and LSS groups was marginally significant at T2 ($p = .057$) (Figure 8.1, p. 194). In fact, the raw distribution of students expected to earn the Abitur mirrors perfectly students' academic standing—measured as end-of-term GPA—from T1 through T4 (cf. Table 8.11 and Figure 8.1, both on p. 194). Only at T5 did students in the AM group show grade improvements that affected their ranking relative to the other groups. However, this progress likely came too late in their academic journey or lacked sufficient momentum to impact the type of school-leaving certificates they were eligible to earn.

The GLM results, combined with crosstab analyses and earlier GPA trends, suggest that differences in school-leaving certificates primarily reflect (baseline) academic standing rather than sustained intervention effects. The AM group's initial academic disadvantage, which persisted throughout the study, likely contributed to the lower percentage of students earning the Abitur in this group. This theory is supported by the long-term nature of the DV: it is unlikely that a brief intervention could have had a sustained impact over a five-year period. While the interventions were associated with GPA improvements, these effects did not occur early enough (AM), were not large enough, or did not persist long enough to alter long-term educational attainment significantly compared to the control group.

To assess whether the *immediate post-intervention effects of the treatments* had any bearing on the long-term outcomes, a secondary model was fitted, replacing T1 with T2 (post-intervention) grades. Controlling for GPA at T1 in the previous analysis aimed to isolate the long-term effects of the intervention, while controlling for GPA at T2 shifted the focus to the persistence of early intervention effects. In other words, it examined whether the short-term

Table 8.11*School-Leaving Certificates * Treatment Crosstabulation*

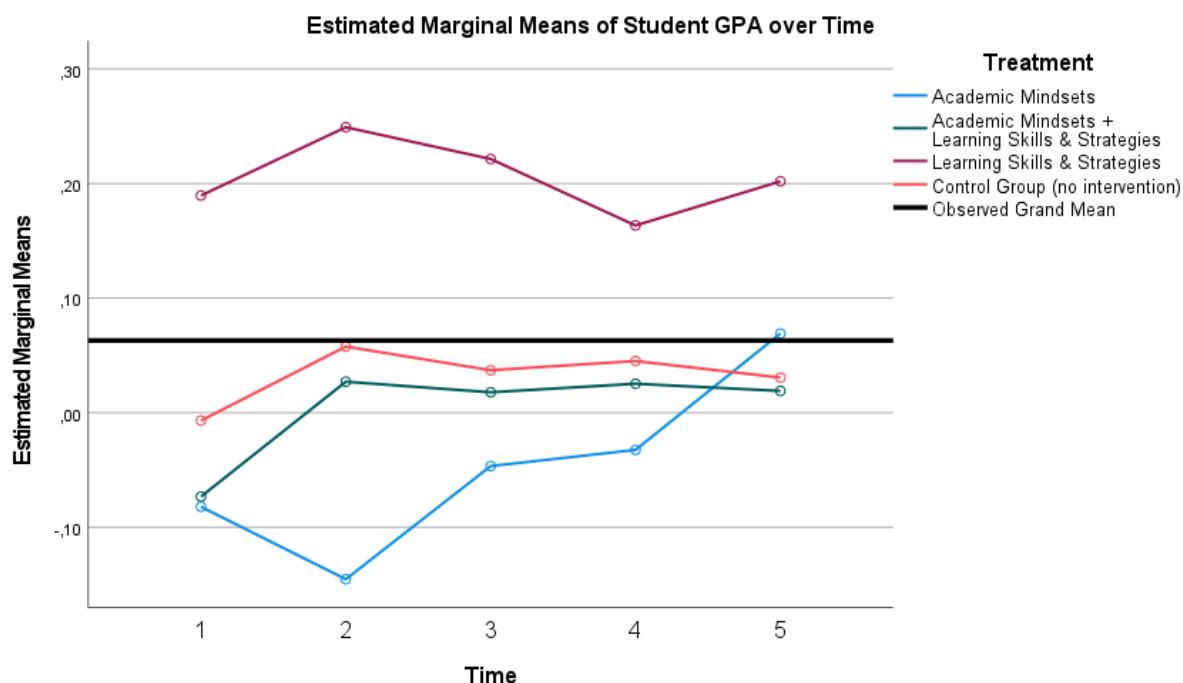
		Treatment									
		AM		COMB		LSS		CG		Total	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Certificate	LLC	14 _a	36.8%	12 _a	24.5%	11 _a	20.0%	7 _a	13.5%	44	22.7%
	MLC	7 _a	18.4%	10 _a	20.4%	6 _a	10.9%	14 _a	26.9%	37	19.1%
	ULC	17 _a	44.7%	27 _a	55.1%	38 _a	69.1%	31 _a	59.6%	113	58.2%
Total		38	100.0%	49	100.0%	55	100.0%	52	100.0%	194	100.0%

Note. AM = Academic Mindsets group, COMB = Combined intervention group, LSS = Learning Skills & Strategies group, CG = Control group

_a Each subscript letter denotes a subset of Treatment categories whose column proportions do not differ significantly from each other at the .05 level (Bonferroni adjustment).

improvements observed at T2 played a significant role in shaping the long-term outcome.

The overall fit of the T2/T5 model was almost identical, explaining 85% of the variance in certificates compared to 84.8% for the T1/T5 model¹⁵¹. As expected, T2 grades

Figure 8.1*Evolution of Student GPA over Time (T1–T5) Across All Conditions*

Note. The figure displays the results of a RM-ANOVA with Time (GPA at T1-T5) as the within-subjects factor and Treatment (AM, COMB, LSS, and control) as the between-subjects factor.

¹⁵¹ Standard ordinal logistic regressions (OLR) were conducted to compare the Nagelkerke pseudo- R^2 values for the two models. Other OLR results were consistent with the GLM, but the latter was preferred for its flexibility in handling categorical predictors, robust estimation functions, and wider range of goodness-of-fit statistics.

were a slightly stronger predictor of school-leaving certificates than T1 grades (Wald $\chi^2(1) = 10.681, p = .001, b = 2.372, SE = 0.725$), though T5 grades remained the strongest predictor (Wald $\chi^2(1) = 27.614, p < .001, b = 5.075, SE = 0.965$). Treatment effects remained consistent across models (T1/T5, $p = .005$; T2/T5, $p = .018$), and differences in covariate effects (e.g., self-control) were minimal. Despite minor differences, the conclusion remains unchanged: the AM group had significantly poorer outcomes than the other groups, likely due to pre-existing academic standing rather than any sustained (negative) impact of the AM intervention. Further research is needed to explore whether such interventions can be optimized for long-term efficacy or if they mainly serve to improve short-term performance.

8.2 Brief Discussion of Results: RQs 3a-g

The analyses for RQ 3 provide partial support for the working hypothesis (WH 3) that participants in the treatment conditions would show greater improvements in academic performance and self-selected goal achievement compared to the control group. Significant differences emerged between intervention and control groups, particularly in GPA and self-selected school goal achievement, an academic outcome of personal relevance to students.

While the interventions did not significantly influence self-reported grit or traits such as conscientiousness, school belonging, or self-efficacy, all intervention groups outperformed the control group in several key areas. The LSS group, and especially the COMB group, showed significant GPA improvements from T1 to T2. The LSS group also achieved school goals to a significantly greater extent than all other groups, while the AM group exhibited a significant GPA increase from T2 to T5 and maintained higher levels of school goal importance compared to the control group. On personal goal progress, the LSS group outperformed the control group, though the effects were modest.

However, neither school engagement nor teachers' evaluations of student progress revealed significant differences between the treatment and control groups, despite a trend favoring the COMB group in teachers' evaluations. Overall, the grit interventions led to meaningful gains in GPA and school goal achievement relative to the control group, while personality traits remained unaffected. These findings support the hypothesis that performance outcomes are more responsive to the interventions than personality measures.

8.3 Research Question 4

8.3.1 Method Overview and Findings (RQ 4)

Ideally, a multivariate analysis would be the most suitable approach to address RQ 4 ("Which is the most effective grit intervention with respect to any of the outcomes measured in this study?"), as it allows for the simultaneous examination of multiple dependent variables

and their interactions. However, SPSS cannot accommodate the concurrent analysis of mixed dependent variable types (continuous, ordinal, and repeated measures) alongside covariates. While Bayesian mixed-effects modeling in R (e.g., via the ‘brms’ package) offers the flexibility to handle these complexities, the relatively small sample size ($n = 187$), the large number of dependent variables (5–12, depending on prioritization), and the inclusion of multiple treatment groups and covariates render such models overly complex and underpowered. Numerous attempts with varying model complexities confirmed these limitations. Therefore, to determine which grit intervention was most effective, it is more practical to evaluate and compare the results of independent analyses for each outcome and report the findings at face value.

In terms of school performance, all three interventions were associated with significant GPA improvements over the study period (T1–T5). The COMB group showed the strongest gains from T1 to T2, followed by the LSS group. However, while the COMB group maintained its improvement across all time points, the LSS group’s initial gains diminished in significance when T5 was included. The AM group exhibited delayed gains, with a significant improvement from T2 to T5. Importantly, each intervention showed significant gains at specific time points, but none demonstrated statistically significant improvements across all time points. Therefore, ranking the interventions in terms of overall effectiveness is not feasible. The most reasonable conclusion is that all three intervention conditions were significantly associated with GPA gains at particular stages, whereas the control group showed no such improvements.

When it comes to self-selected goal achievement, the LSS intervention yielded the most substantial effects, with students in this group scoring significantly higher on school goal progress, school goal importance, and personal goal progress than their peers. While the AM intervention appeared to help participants place greater value on their school goals, this did not translate into greater progress toward said goals. Contrary to expectations, the COMB group did not outperform the other groups on any measure of goal achievement, suggesting that combining interventions may not yield additive benefits in this domain.

Even though none of the interventions significantly influenced teacher evaluations at T2, the COMB group showed a trend toward more favorable evaluations, whereas the LSS group exhibited a trend toward less favorable evaluations compared to other groups.

With regard to educational attainment, The AM group was significantly less likely to achieve higher-level school-leaving certificates than the control group. Conversely, the LSS group had the highest proportion of upper-level certificates (ULC), but this difference was not

statistically significant. Both of these findings likely reflect baseline differences in academic standing between the treatment groups, rather than any intervention effects. Thus, ranking the interventions based on educational attainment is not particularly meaningful.

Overall, the hypothesis that the combined intervention would yield greater improvements across academic measures and goal achievement compared to the individual interventions is only partially supported. The COMB intervention was effective in improving GPA in the short term, which may have contributed to slightly more favorable teacher evaluations, but it did not enhance goal achievement and—like the other interventions—appeared to have no bearing on long-term educational attainment. These findings highlight the heterogeneous nature of intervention effects and may indicate that different outcomes require tailored approaches to maximize effectiveness.

8.4 Research Question 5

8.4.1 Method Overview (RQ 5)

A hybrid Latent Class/Latent Profile Analysis (LCA/LPA) was conducted using the ‘Mclust’ package in R to identify distinct student profiles based on a combination of categorical and continuous variables. The clustering factors included cohort (Grade 7, 8), gender (male, female), SEA Index (low, medium, high), general grit, school grit, and school engagement (all three continuous). The primary goal was to identify students who may be disadvantaged in the school context, either due to lower levels of grit and school engagement or because they belong to a lower socio-educational category. Gender and cohort were also included to assess their potential role in these groupings, though the focus remained on capturing dimensions of socio-educational and motivational disadvantage¹⁵².

LCA/LPA was chosen because it efficiently summarizes multidimensional data into a single ‘Cluster’ variable. Including all clustering factors as separate between-subject variables alongside Treatment would drastically reduce the number of cases per cell, potentially resulting in many unique combinations with few or no participants, thereby hindering meaningful comparisons across treatment groups and weakening the statistical power of the analysis. By reducing analytical complexity, LCA/LPA preserves statistical power while still capturing meaningful differences between student profiles.

Furthermore, while moderation analysis could test interactions between these variables and Treatment, tools like Hayes’ PROCESS macro cannot accommodate repeated measures DVs, such as GPA measured at multiple time points. Since the goal was to investigate

¹⁵² It is worth noting that being male may also represent a disadvantage in the German education system—a topic that will be touched upon later in this chapter and in Chapter 10.

whether certain students benefitted more from the interventions—specifically, whether some showed greater positive changes in GPA over time—the LCA/LPA approach, followed by RM-ANCOVAs with Treatment and ‘Cluster’ as between-subject variables, provides a robust method to group students into meaningful profiles and examine their differential responses to the interventions over time.

8.4.2 Statistical Analyses and Results (RQ 5)

The LCA/LPA revealed two distinct clusters (Table 8.12, p. 199). Cluster 1 ($n = 105$) was characterized by lower levels of general grit ($M = -0.38$), school grit ($M = -0.51$), and engagement ($M = -0.17$). Notably, this cluster included a higher proportion of students from the low SEA category (33% vs. 14% in Cluster 2), and was predominantly male (64%). Cluster 2 ($n = 82$) showed higher levels of general grit ($M = 0.51$), school grit ($M = 0.72$), and engagement ($M = 0.28$), with a greater representation of females (59%), Grade 8 students (61%), and students from higher SEA categories. Thus, the clustering process provided a clear distinction between disadvantaged (Cluster 1) and more advantaged (Cluster 2) groups.

Analysis of Academic Outcomes across Two Time Points. A RM-ANCOVA was conducted to examine the effect of intervention type (Treatment: four levels) and student profile (Cluster: two levels) on changes in GPA over time (Time: T1 vs. T2) while controlling for conscientiousness, school belonging, school self-efficacy, and mindset¹⁵³. The analysis included 186 students: 104 in Cluster 1 and 82 in Cluster 2. Descriptive statistics for these GPA variables are found in Appendix F.5 (p. 352).

The within-subjects effect of Time was significant, $F(1, 174) = 5.309, p = .022$, indicating that GPA improved significantly from T1 to T2 across all conditions. The between-subjects effect of Treatment was not significant, $F(3, 174) = 1.467, p = .225$, confirming that groups were comparable before the intervention. Cluster membership had a significant between-subjects effect, $F(1, 174) = 13.941, p < .001$, with Cluster 2 students having higher GPAs on average compared to Cluster 1 students ($M_{\text{diff}} = 0.522, SE = 0.140, 95\% \text{ CI } [.246, .798], p < .001$). Bonferroni-adjusted pairwise comparisons further revealed that Cluster 1 had significantly lower GPA scores than Cluster 2 in three out of four conditions, and marginally lower scores in the AM group, confirming the initial academic advantage of students in Cluster 2. Conscientiousness, self-efficacy, and mindset also had significant between-subject

¹⁵³ The variables used in the clustering process were not included as covariates. Their influence is already accounted for through the cluster grouping, so adding them as covariates would not provide additional explanatory power and could lead to over-controlling for these effects. However, I included the remaining covariates to ensure comparability with the original repeated measures analysis that did not include clusters. The observations per predictor ratio for the final ANCOVA model was $186 / 18 = 10.33$.

Table 8.12*Student Cluster Profiles Based on Demographics, Grit, and School Engagement*

Cluster	Gender (M/F)	Cohort (Grade 7/8)	SEA (Low/Mid/High)	G. Grit <i>M</i>	S. Grit <i>M</i>	ScEng <i>M</i>
C1	67/38 (63.8%/36.2%)	51/54 (48.5%/51.5%)	35/45/25 (33.3%/42.9%/23.8%)	-0.379	-0.509	-0.174
C2	34/48 (41.5%/58.5%)	32/50 (39%/61%)	12/46/24 (14.6%/56.1%/29.3%)	0.515	0.716	0.282
<i>M_{Diff}</i>	—	—	—	0.894	1.225	0.456

Note. G. Grit = general grit (T1), S. Grit = school grit (T1), ScEng = school engagement (T1), *M_{Diff}* = mean difference

effects, emphasizing the importance of controlling for these variables to isolate intervention effects. Table 8.13 (p. 200) presents selected within-subjects and between-subjects effects.

The interaction between Time and Treatment was significant, $F(3, 174) = 3.471$, $p = .017$, confirming the results of the analysis in section 8.1.6 (RQ 3e) and indicating that students in different conditions showed different patterns of GPA change over time. A non-significant within-subjects effect was found for Time * Cluster ($p = .309$), suggesting that baseline cluster characteristics alone did not drive GPA changes. Instead, the interventions likely influenced these patterns. A further non-significant between-subjects effect for Treatment * Cluster ($p = .956$) is also desirable because it indicates that GPA patterns within each cluster—averaged across time points—were consistent across conditions. In other words, if one cluster tended to have higher or lower grades overall, this pattern was consistent across all groups. This is important because it helps ensure that observed changes in GPA are not simply driven by differences between the clusters across conditions, but reflect genuine intervention-driven effects over time.

Most importantly, the three-way interaction between Time, Treatment, and Cluster bordered on conventional significance, $F(3, 174) = 2.567$, $p = .056$. This result signals that students in different conditions showed different patterns of GPA change over time, and these patterns varied by student profile, with some groups benefitting more from certain interventions than others. Significant pairwise comparisons and multivariate tests for the Treatment * Time * Cluster interaction are presented in Table 8.14 (p. 200).

Students in Cluster 1 showed a significant improvement in GPA from T1 to T2 across conditions ($p = .014$), whereas students in Cluster 2 experienced a smaller, non-significant improvement ($p = .506$). Further analysis of within-group changes revealed that these effects were driven by the COMB intervention group ($p < .001$) and the LSS group ($p = .012$), echoing previous RM-ANCOVA findings (section 8.1.6). Importantly, students in Cluster 2

Table 8.13*Selected Within-Subjects and Between-Subjects Effects on GPA (T1 to T2)*

Effect	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>	<i>pη</i> ²
Within-subjects					
Time	5.309	1	174	.022	.030
Time * Treatment	3.471	3	174	.017	.056
Time * Treatment * Cluster	5.321	3	174	.056	.042
Time * Cluster	1.042	1	174	.309	.006
Between-subjects					
Treatment	1.467	3	174	.225	.025
Cluster	13.941	1	174	< .001	.074
Treatment * Cluster	0.108	3	174	.956	.002
School self-efficacy	20.409	1	174	< .001	.105
Mindset	7.360	1	174	.007	.041
Conscientiousness	4.303	1	174	.040	.027

Note. The table displays results from a RM-ANCOVA with Time (GPA at T1 and T2) as the within-subjects factor and Treatment (1/2/3/4) and Cluster (1/2) as the between-subjects factors.

stagnated or improved non-significantly in these treatment groups, suggesting potential ceiling effects and highlighting that the interventions' positive effects were primarily driven by their impact on the disadvantaged group (Cluster 1). In the control group, both clusters showed minimal and non-significant improvement, with Cluster 2 improving slightly more, which is what would naturally occur over time in the absence of any intervention. The fact that Cluster 1 improved *only in the treatment conditions* strengthens the argument that these changes were driven by the interventions rather than by natural improvement over time. Lastly, both clusters saw a small, non-significant GPA decline in the AM group from T1 to T2, indicating no immediate impact of the academic mindsets intervention on school performance for either group.

Table 8.14*Significant Pairwise Comparisons and Multivariate Tests for Time * Treatment * Cluster (T1 to T2)*

Tx./CL	Mean Diff.	SE	<i>p</i> ^b	95% CI		Multiv. Test	<i>V</i>	<i>F</i>	H. <i>df</i>	E. <i>df</i>	<i>pη</i> ²
				<i>LL</i>	<i>UL</i>						
COMB/1	.201 ^a	.049	< .001	.105	.297	Pillai's Trace	.089	17.074	1	174	.089
LSS/1	.120 ^a	.047	.012	.026	.214	Pillai's Trace	.035	6.399	1	174	.035

Note. Tx. = Treatment group; CL = Cluster; COMB = combined intervention group (AM + LSS); LSS = Learning Skills & Strategies group; Mean Diff. = Mean difference; H. *df* = Hypothesis degrees of freedom; E. *df* = Error degrees of freedom.

^a Time 2 - Time 1

^b Adjustment for multiple comparisons: Bonferroni.

When examining the net intervention effects on GPA, the impact on Cluster 1 students—defined by lower SEA and academic ability—is characterized by substantially larger effect sizes compared to those observed in the overall sample analyzed in RQ 3e. In the full sample, the model-based quotient effect sizes (q) for the COMB and LSS conditions (T1 to T2, relative to control) were 2.000 and 1.161, respectively. However, for Cluster 1 students specifically, these q values increased dramatically to 4.444 (COMB) and 2.667 (LSS), indicating that Cluster 1 participants in the COMB condition experienced GPA gains nearly 4.5 times greater than their peers in the control group, while those in the LSS condition achieved gains over 2.5 times larger. A similar trend emerged with the between-group Cohen's d_s values. For the overall sample, the COMB and LSS conditions yielded d_s values of 0.076 and 0.013, respectively, which were cautiously interpreted as medium and small effects. Yet, when focusing on Cluster 1 students, these d_s values rose to 0.191 (COMB) and 0.098 (LSS), underscoring the amplified effectiveness of the interventions for disadvantaged and lower-performing students.

Extended Analysis across Three Time Points. Adding GPA at T5 as a third time point in the RM-ANCOVA revealed several important findings. First, the Time * Treatment within-subjects effect remained significant (Greenhouse-Geisser-corrected $p = 0.46^{154}$, with a significant quadratic contrast, $p = .001$). *Across clusters*, the AM group showed a significant GPA increase from T2 to T5 ($p = .013$), the COMB group sustained its significant progress from T1 to T2 ($p = .028$), while the LSS group's initial gains were no longer significant when T5 was included. These findings align perfectly with those from the prior repeated-measures analysis that did not differentiate students by Cluster (RQ 3e, section 8.1.6).

Second, the Time * Cluster effect *became* significant ($p = .003$, with a significant linear contrast $p = .004$). This suggests that cluster membership plays a larger role in GPA changes over an extended period, irrespective of condition. *Between-cluster* comparisons showed highly significant differences in GPA at both T1 and T2, which became marginally significant by T5 ($p = .077$), suggesting that the disadvantaged group (Cluster 1) was catching up. *Within-cluster* comparisons showed that in Cluster 1, GPA at T5 was significantly higher than at T1 and T2 ($p = .002$ and $p = .035$, respectively), whereas in Cluster 2 it did not differ significantly between any time points (T1/T2, T1/T5, T2/T5). In summary, when averaging across all conditions, meaningful GPA changes over time were observed only in Cluster 1.

Third, the Time * Treatment * Cluster interaction was no longer significant ($p = .475$),

¹⁵⁴ Mauchly's Test had shown that the assumption of sphericity was not met. The Greenhouse-Geisser correction was applied to all applicable significance coefficients in this analysis.

likely because averaging effects over time and treatments can obscure more specific patterns. This result may also reflect insufficient statistical power to detect subtle effects in a model of this complexity. However, the absence of a significant higher-order interaction does not rule out the possibility of localized effects. These effects can only be explored through (significant) EMM-based pairwise comparisons, which, in this case, align with WH 5, reflecting anticipated differences in treatment effects across clusters over time. Some methodological perspectives (e.g., Hsu, 1996) underscore the value of examining theoretically driven comparisons even in the absence of a significant overall interaction. As such, these pairwise comparisons are interpreted cautiously, mindful of the ongoing debate about their validity under such circumstances.

The most important findings of the extended long-term analysis are: 1) the significant GPA improvement in the AM group from T2 to T5 is driven solely by Cluster 1 ($M_{\text{diff}} = 0.288$, $SE = 0.099$, 95% CI [.050, .527], $p = .012$), with a non-significant improvement in Cluster 2; 2) Cluster 1's improvement in the COMB condition remains strong through T5 (GPA at T5 is significantly higher than at T1, $p = .017$); 3) Cluster 1's gains in the LSS group from T1 to T2 remain marginally significant ($p = .082$); and 4) Cluster 2 in the control group experiences a significant drop in GPA between T2 and T5 ($p = .027$) after a non-significant improvement from T1 to T2. Thus, across a two-and-a-half-year period, Cluster 1 shows significant positive changes in the AM and COMB groups, marginally significant gains in the LSS group, and no significant improvements in the control group. This indicates that the GPA gains observed in Cluster 1 are unlikely to result solely from natural progression over time. Conversely, Cluster 2 shows no significant changes across time in any of the intervention groups but experiences a significant GPA drop in the control group between T2 and T5. This pattern indicates that the interventions may have acted as a protective factor, helping to maintain GPA levels for the more advantaged, higher-performing students in Cluster 2.

The effect sizes for the extended analysis with three time points corroborate the notable differences between clusters across the intervention conditions. From T1 to T5, Cluster 1 students improved in the COMB group approximately twice as much as in the control group ($q = 2.030$), corresponding to $d_s = 0.171$ —a larger effect compared to that observed for the COMB intervention undifferentiated by cluster ($d_s = 0.118$, see RQ 3e). Similarly, from T2 to T5, Cluster 1 improved in the AM group 3.2 times more than in the control group, corresponding to $d_s = 0.180$. Given that more advantaged Cluster 2 students improved (non-significantly) in the AM group but declined significantly in the control group from T2 to T5, this widening gap resulted in the largest standardized effect size in this

analysis: a $d_s = 0.431$, underscoring the intervention's strong stabilizing effect for students with higher SEA and higher baseline GPA.

Altogether, the findings from both analyses strongly support WH 5, which posited that socially disadvantaged or academically weaker students would benefit more from the grit interventions. These results align with prior research (e.g., Paunesku et al., 2015; Santos et al., 2021; Yeager, Walton, et al., 2016; Yeager & Dweck, 2012), which attributes such outcomes to both intervention and ceiling effects. The lack of significant improvement for Cluster 2 underscores the limitations of a one-size-fits-all approach and highlights the need for tailored interventions to achieve more than just a protective effect for higher-performing students.

The overrepresentation of male students in the less advantaged, academically weaker cluster aligns with research pointing to gender bias against boys in the German education system. Early tracking, which typically occurs at the end of fourth grade in most German states, disproportionately impacts boys due to their relatively slower development at age 10, often resulting in placement decisions that limit their future educational opportunities (Jürges & Schneider, 2011). This issue is compounded by a second factor, not unique to Germany but amplifying the disparities caused by early tracking: implicit teacher preferences, reflected in academic track recommendations. Teacher-assigned grades often reward non-cognitive skills like self-regulation (e.g., attentiveness, sitting still) and compliance—behaviors more commonly displayed by girls. For instance, Boehnke (1996), in a cross-cultural study of over 2,500 secondary school students, found that aggressiveness is a stronger predictor of school-related rule abidance for boys than for girls, whereas obedience in school strongly predicts performance for both genders. Thus, the fact that students in Cluster 1 benefitted more from the grit interventions highlights the potential of such interventions to address also gender disparities in academic performance.

8.5 Research Question 6

8.5.1 Method Overview (RQ 6)

To examine the mechanism through which the grit interventions influenced school performance, a mediation analysis with school engagement at T2 as the mediator and GPA at T1 and T3 as the repeated measures DV was carried out. Since the interventions' impact on students' grades is hypothesized to occur at least partly through school engagement, only the *post*-intervention measure of engagement (T2) can appropriately serve as the mediator. GPA at T3 was chosen over GPA at T2 because the latter was collected after the intervention but prior to the administration of the second round of self-report measures, including engagement. In contrast, GPA at T3 represents the first academic outcome measured (shortly) after school

engagement at T2, making it the most suitable measure for this analysis. A limitation of this choice is that GPA decreased non-significantly from T2 to T3 for all groups except the AM group. Consequently, the overall change in GPA from T1 to T3 is smaller than the change from T1 to T2. This reduction may result in modest total effects in the mediation model, as the observed interventions' impact on GPA change may be diminished.

Given that the mediator is a T2 variable, self-reported measures from T2 were included as covariates to capture time-specific influences. Variables like school grit and school belonging at T2 are more likely to impact school engagement (mediator) and GPA (outcome) within the same timeframe than measures taken eight months earlier. These T2 variables, though they remained largely stable post-intervention, as noted in sections 8.1.2 and 8.1.3, reflect the immediate context in which the interventions' effects occur while also capturing underlying baseline differences between treatment groups. The selected covariates—cohort, SEA Index, school grit, school self-control, and school belonging—were chosen for their theoretical relevance and ability to enhance model performance without overfitting, striking a balance between parsimony and explanatory power. For additional context, Appendix F.6 (p. 353) provides the bootstrapped bivariate correlations among T2 self-report measures and their relationships with GPA at T3.

To preserve the time-dependent nature of the data in the mediation analysis, repeated measures for GPA were used to capture changes over time while accounting for within-subject correlations. This approach leverages the full longitudinal data structure, maintaining statistical power and improving accuracy compared to residual-based methods (e.g., using a residual change score in Hayes' PROCESS macro), which may oversimplify temporal dynamics. A linear mixed model (LMM) was employed using the *lmer* function in R's 'lme4' package to model the repeated measures appropriately. LMMs are well-suited for longitudinal data as they include random intercepts to capture individual variability in baseline GPA. For the mediator model (engagement), which was measured at T2, an ordinary least squares (OLS) linear regression model was applied using the *lm* function in the base R package.

Indirect effects (path *ab*) were estimated via bootstrapping with 1,000 resamples, leading to robust confidence intervals (CI) for the mediation pathways. Total effects (path *c*) and direct effects (path *c'*) were derived from the LMM, with bootstrapped CI tallied for both.

8.5.2 Statistical Analyses and Results (RQ 6)

Before proceeding with the mediation analysis, which incorporated students' GPA at T3 (not previously analyzed), the distribution of this variable was assessed using the Kolmogorov-Smirnov test and found to meet the assumption of normality.

In path *a*, the relationship between Treatment and the mediator, school engagement at T2, was assessed using an ordinary least squares (OLS) regression. The analysis revealed that participants in the AM and LSS groups reported significantly higher engagement at T2 compared to the control group ($b = .146, p = .013$ and $b = .174, p < .001$, respectively), while the COMB group did not differ significantly from control ($p = .244$). The model explained 46.8% of the variance in engagement, with school grit ($b = .266, p < .001$), SEA ($b = .098, p < .001$), and school self-control ($b = .070, p = .003$) emerging as significant predictors alongside the LSS intervention. Treatment contributed 4.1% to the explained variance, suggesting modest but noticeable effects on student engagement.

The second model (path *b*), which examined the effect of engagement on GPA change from T1 to T3 while controlling for Treatment and covariates, showed that engagement at T2 was a significant positive predictor of GPA ($b = .352, p = .014$). Each unit increase in school engagement corresponds to a 0.35-unit increase in GPA, indicating that more engaged students achieve greater academic gains. SEA ($b = .250, p < .001$) and school grit ($b = .222, p = .013$) also significantly predicted GPA, suggesting that socio-educational advantage and grit contribute to GPA growth. A small but significant effect of Time ($b = .054, p = .046$) indicated an overall positive change in GPA across all students, even when controlling for other factors. Consistent with the mediation hypothesis, Treatment did not predict GPA in path *b*. The model explained 35.7% of the variance in GPA based on the marginal R^2 , reflecting the variance attributable to the fixed effects (i.e., mediator, Treatment, covariates).

The total effects of Treatment on GPA (path *c*) differed across groups. While the fixed effects model yielded a non-significant p -value for the LSS condition, the bootstrapped analysis revealed a statistically significant total effect on GPA ($b = .161, 95\% \text{ CI } [.027, .290]$), indicating that this intervention's combined direct and indirect effects contributed to GPA change compared to the control group. In contrast, the total effects of the AM and COMB treatments on GPA remained non-significant¹⁵⁵. The total effects model explained 33.6% of the variance in GPA change from T1 to T3 (marginal R^2), with SEA and school grit emerging as highly significant predictors ($p < .001$). The difference between the variance explained in path *b* (35.7%) and path *c* (33.6%) can be attributed to the mediator variable (2.1%),

¹⁵⁵ This result arises despite an exploratory RM-ANCOVA examining GPA changes from T1 to T3, which found marginally significant gains for the COMB group ($p = .077$) but non-significant gains for the other conditions. For the LSS group, the significant total effect in the mediation analysis reflects the contribution of the indirect pathway through school engagement, even though direct effects (and overall within-group GPA gains) were weak or non-significant. In contrast, while the COMB group demonstrated more noticeable raw GPA gains compared to the LSS group, the mediation analysis indicates that these gains were not linked to a clear direct or mediated mechanism.

demonstrating that school engagement contributes to predicting GPA change over time.

The direct effects of Treatment on GPA (path c') indicated that none of the grit interventions had a significant direct impact on GPA after controlling for school engagement. Notably, the significant total effect observed for the LSS group disappeared when school engagement was included as a mediator, hinting that the influence of the LSS intervention on GPA operates fully through its association with engagement.

The indirect effects (path ab), representing the mediated relationship between Treatment and GPA via school engagement, revealed interesting patterns. Significant indirect effects were observed for Treatment 1 (AM group) and Treatment 3 (LSS group), with AM contributing .052 (95% CI [.006, .099]) and LSS contributing .061 (95% CI [.018, .111]) to GPA change through higher levels of school engagement at T2. In contrast, the indirect effect of Treatment 2 (COMB group) was negative but non-significant ($b = -0.022$, 95% CI [-.066, .011]), indicating no meaningful mediation effect in this group compared to the control group. Table 8.15 (below) provides an overview of the findings from this mediation analysis.

Table 8.15

The Effects of Grit Interventions on Δ GPA (T1-T3) Mediated by School Engagement (T2)

Path	b^*	SE b^*	t	p	95% CI for b^*		R^2
					LL	UL	
Tx. 1 $\rightarrow$ ScEng (a)	.146	.059	2.50	.013	.023	.264	.468
Tx. 2 $\rightarrow$ ScEng (a)	-.063	.054	-1.17	.244	-.161	.038	
Tx. 3 $\rightarrow$ ScEng (a)	.174	.052	3.37	< .001	.065	.275	
ScEng $\rightarrow$ Δ GPA (b)	.352	.142	2.47	.014	.217	.500	.336 ^a
Tx. 1 $\rightarrow$ Δ GPA (c'), DE	-.095	.153	-0.62	.533	-.230	.028	
Tx. 2 $\rightarrow$ Δ GPA (c'), DE	.034	.140	0.24	.807	-.096	.166	
Tx. 3 $\rightarrow$ Δ GPA (c'), DE	.102	.135	0.75	.452	-.039	.230	
Tx. 1 $\rightarrow$ Δ GPA (c), TE	-.044	.154	-0.28	.776	-.180	.085	
Tx. 2 $\rightarrow$ Δ GPA (c), TE	.012	.141	0.08	.933	-.121	.146	
Tx. 3 $\rightarrow$ Δ GPA (c), TE	.161	.135	1.21	.229 ^b	.027	.290	
Time $\rightarrow$ Δ GPA (b, c, c')	.054	.026	2.01	.046	-.017	.123	
Indirect effect Tx. 1 (ab)	.052	—	—	Sig.^b	.006	.099	
Indirect effect Tx. 2 (ab)	-.022	—	—	n.s.	-.066	.011	
Indirect effect Tx. 3 (ab)	.061	—	—	Sig.^b	.018	.111	
Full model (abc')	—	—	—	—	—	—	.357 ^a

Note. ScEng = School engagement (T2); Tx. 1 = Treatment 1; Tx. 2 = Treatment 2; Tx. 3 = Treatment 3; Δ GPA = change in GPA (T1 – T3); DE = Direct effect, TE = Total effect; Sig. = significant (0.05 level); n.s. = not significant (0.05 level)

* Denotes an unstandardized regression coefficient, not to be confused with path b .

^a Marginal R^2

^b The effect is significant if 0 is not included in the bootstrapped confidence interval.

The mediation analysis confirmed that the AM and LSS interventions indirectly affected GPA through school engagement. For the LSS group, the improvement in GPA from T1 to T3 can be fully explained by school engagement levels at T2, suggesting a full mediation effect. In the AM group, despite significant associations with school engagement (path a) and a significant indirect effect on GPA, neither the direct nor the total effects on GPA were significant. Hence, while school engagement also played a mediating role in the AM group, the overall influence on GPA change was not strong enough to differentiate this group from the control group.

In sum, the hypothesis (WH 6) that the grit interventions influence GPA through school engagement is partially supported, with significant indirect effects observed in two treatment conditions and one instance of full mediation. Together with the cross-sectional analysis results demonstrating that school engagement mediates the relationship between school grit and GPA, the current findings highlight school engagement as an important behavioral mechanism through which both grit and the grit interventions may contribute to improved academic performance.

8.6 Summary of Findings for the Quantitative Strand of the Study

The quantitative strand of this mixed-methods study examined the relationships between general and school-specific grit, their associations with related constructs, and their ability to predict GPA (Chapter 7). It further assessed the impact of targeted grit interventions on various academic outcomes and the achievement of personally valued goals (Chapter 8). All hypotheses were either fully or partially supported. For a comprehensive summary of the research questions, hypotheses, and findings, refer to Table 8.16 on p. 209.

The cross-sectional results demonstrated that school grit is a stronger predictor of GPA than general grit, aligning with research emphasizing the value of context-specific measures for understanding educational outcomes (e.g., Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). As hypothesized, school grit explained incremental variance in GPA after controlling for demographic variables and other psychological measures, despite mixed evidence in prior research regarding grit's unique explanatory power (e.g., Credé et al., 2017). School grit was the third best predictor of students' GPA after socio-educational advantage and school self-efficacy, contributing 17-21% to the total explained variance in GPA. Notably, grit's influence was most pronounced for socio-educationally disadvantaged and academically weaker students, suggesting that interventions targeting grit may be particularly beneficial for these groups. Mediation analyses confirmed that engagement serves as a mechanism through which school grit influences academic performance, providing support

for the hypothesized model introduced in Chapter 3.

The longitudinal findings revealed that the interventions did not significantly alter self-reported grit, conscientiousness, school belonging, self-control, self-efficacy, or mindset, consistent with the notion that shifts in personality traits require recurrent or enduring changes in personality *states* (e.g., the manifestations of grit or self-control) (Bleidorn et al., 2019). However, the interventions' impact on self-reported school engagement yielded mixed results. While the RM-ANCOVA found no significant increase in school engagement from T1 to T2 in any condition (RQ 3c), the mediation analysis (RQ 6) revealed that participation in certain interventions (AM and LSS) was associated with higher school engagement levels at T2 relative to the control group, which subsequently contributed to GPA growth from T1 to T3.

The grit interventions, as anticipated, resulted in significant improvements in both short-term and longer-term academic outcomes, particularly GPA and school goal achievement. Consistent with findings from the cross-sectional study, these positive effects were most pronounced among disadvantaged and lower-performing students. However, more advantaged students also appeared to benefit, as those in the treatment groups avoided the decline in school performance observed in the control group. Given that academic performance typically declines during middle school and early adolescence (Blackwell et al., 2007; Obermeier et al., 2023; Park et al., 2017, 2020; Postigo et al., 2020, 2021), the grit interventions' observed effects on GPA during this critical period—even mere maintenance among the better-performing students—represent a noteworthy accomplishment.

The combined intervention showed the greatest promise in improving GPA, though the hypothesized greater impact compared to the single-focus interventions was only partially supported. Moreover, teacher evaluations and students' long-term educational attainment did not reflect the gains seen in GPA. These findings suggest that grit-focused interventions may not lead to uniform improvements across all academic outcomes but show significant potential for supporting meaningful academic progress among students who need it the most. Future research and practice can build on these insights to refine and expand grit-based approaches in school settings.

Table 8.16*Overview of Research Questions, Hypotheses, and Findings for the Quantitative Strand*

Research question	Hypothesis / Assumption	Findings	Conclusion
RQ 1: How do domain-general and school-specific grit relate to other constructs in their nomological network?	Assumptions: Grit expected to correlate negatively with mindset and positively with all other variables.	Grit correlated significantly with conscientiousness, school self-efficacy, school self-control, and engagement, but not mindset.	Assumptions were largely met.
RQ 2a: How strongly do students' grit and the other variables relate to students' GPA? Do the grit variables explain unique variance in GPA over and above the other constructs?	WH 2a: Grit, especially perseverance, will positively relate to GPA; School grit expected to predict GPA more strongly than general grit; Grit to explain variance in GPA beyond other measures.	Higher SEA, school grit, and self-efficacy, as well as being female, were linked to higher grades. School grit strongly predicted GPA, while general grit did not. School grit explained variance in GPA beyond other constructs.	Hypotheses were largely confirmed. Perseverance did not outperform overall grit.
RQ 2b: What is the relative importance of the grit variables for GPA when including all other predictors simultaneously in the analytic model?	No specific hypothesis due to the exploratory nature of this RQ.	Exploratory findings: school grit emerged as the third most important predictor of GPA, after SEA and school self-efficacy.	
RQ 2c: Is the impact of grit on GPA moderated by students' socio-educational advantage (SEA), gender, cohort, or academic ability?	WH 2c: Grit's association with GPA stronger for students lower in SEA and academic ability; Cohort and gender less likely to moderate this link.	SEA and academic ability emerged as moderators. School grit predicted grades more strongly for low SEA students and those with both low <i>and</i> high ability. Cohort and gender were not moderators.	Hypotheses were largely confirmed. Finding for high-ability students was unexpected.
RQ 2d: Is the impact of grit on GPA mediated by students' school engagement?	WH 2d: Grit's impact on GPA will be mediated by school engagement.	School engagement significantly mediated the relationship between grit and GPA.	Hypothesis was confirmed.
RQ 3x: How do the interventions affect: a: general and school grit over time? b: conscientiousness, school belonging, school self-control, school self-efficacy, and fixed / growth mindset over time? c: school engagement over time? d: personal and academic goals? e: students' grades / GPA over time? f: teachers' appraisal of school progress? g: students' educational attainment?	WH 3x: Interventions expected to improve measures of academic performance and lead to greater achievement of self-selected goals. Treatments are likely to have a stronger effect on behavioral rather than personality measures.	The grit interventions improved GPA and goal achievement compared to the control group but did not significantly affect teachers' evaluations and students' educational attainment. The interventions had effects on some of the behavioral measures, but not on the personality measures.	Hypotheses were partially confirmed. The grit interventions had effects on some, but not all of the outcomes.
RQ 4: Which is the most effective grit intervention with respect to any of the outcomes measured in this study?	WH 4: Combined intervention expected to perform best for all outcomes.	The COMB intervention was most effective at improving GPA in the short term but did not outperform the AM and LSS interventions otherwise.	Hypothesis was partially confirmed.
RQ 5: Which students benefit more from the interventions? Are they particularly effective for socially disadvantaged or poorly performing students?	WH 5: Students with lower SEA and academic ability expected to benefit more.	Interventions were more effective for socially disadvantaged and academically weaker students.	Hypothesis was confirmed.
RQ 6: How do the grit intervention(s) impact GPA? Is students' school engagement mediating this relationship?	WH 6: School engagement will mediate the link between the interventions and GPA.	ScEng mediated the impact on GPA in the AM and LSS groups, with a full mediation for LSS.	Hypothesis was partially confirmed.

9 Qualitative Strand: Student Perspectives on School, Learning, and the Impact of the Grit Interventions

This chapter examines the beliefs, attitudes, and everyday (learning) behaviors that may underlie the effects of the grit interventions on academic outcomes and self-selected goal achievement. It also investigates students' perceptions of the interventions' impact and their opinions about the use of such grit-focused tools in the school context. Presented to students simply as online courses, the grit web-based interventions aimed to cultivate a growth mindset—the belief that abilities can improve through effort—along with future-oriented thinking (a sense of purpose) and a feeling of school belonging. Furthermore, the interventions sought to equip students with key learning skills and strategies, such as self-control, deliberate (deep) practice, and goal-setting, to help them navigate academic challenges effectively. While much of the research on grit has focused on its relationship with academic achievement, less attention has been given to the specific mindsets and behaviors that mediate its effects, particularly from the students' perspectives. Gaining a deeper understanding of how these interventions shape psychological and behavioral processes is crucial for refining the intervention tools and improving students' educational outcomes.

As described in the Method chapter (section 5.2), the current research employs a mixed-methods approach with a sequential explanatory design to investigate the effects of the grit interventions. The qualitative strand, which constitutes the *evaluation phase* of the broader research project, delves deeper into the potential mechanisms driving the observed outcomes. Through focus group discussions with students, this strand explores factors like learning-related attitudes and habits, providing rich, nuanced insights that explain and contextualize the patterns identified in the quantitative findings. This integration offers a more comprehensive understanding of how the grit interventions can influence student outcomes.

To guide this investigation, two research questions (RQs) were formulated: RQ 7, “What are the academic mindsets and behaviors underlying the effects of the grit interventions?” and RQ 8, “How do students evaluate the grit interventions?” The working hypothesis 7 (WH 7) posits that growth- and future-oriented thinking, along with school engagement, are positively associated with improved school performance. In contrast, RQ 8 is exploratory, aiming to capture students' evaluations of the grit courses without pre-specified assumptions, thus enabling the identification of unanticipated insights and a deeper exploration of their subjective experiences.

To address these research questions, I conducted four focus groups with students from

two cohorts (Grade 8 and Grade 9), divided according to their academic progress—specifically, whether they had improved or stagnated/worsened after the intervention. The focus group discussions centered on students’ attitudes toward school, their study habits, their reflections on the value and impact of grit-focused content, and their feedback regarding the design of the interventions.

The chapter is structured as follows: The first part presents the methodology, detailing the sampling strategy, sample size, the rationale for using focus groups as the data collection method, and the procedures employed for collecting the data. In the middle part, I outline the data analysis process, justifying the choice of a general inductive approach over other qualitative analysis methods, and explaining the steps taken during the inductive coding procedure. This part also contains the results, organized into key categories that emerged from the data, with cross-group comparisons highlighting differences between students who improved academically and those who did not. The discussion section follows, where I interpret these findings in relation to existing literature and reflect on how they address the two research questions associated with the qualitative strand. This section also outlines practical implications for the design and implementation of future grit interventions within educational settings. The chapter concludes with an evaluation section, which examines the trustworthiness of the qualitative research, addressing criteria such as credibility, dependability, confirmability, and transferability. Ethical considerations related to participant consent, confidentiality, and the potential influence of researcher bias are also discussed.

9.1 Sampling Strategy

For the qualitative strand, I employed *mixed purposeful sampling* to select participants based on specific criteria relevant to the research questions. Purposeful sampling, a form of non-probability sampling, focuses on selecting participants who are considered ‘information-rich cases’—those from whom “one can learn a great deal about issues of central importance to the purpose of the inquiry” (Patton, 2014, p. 230). In my case, the overarching strategy involved a combination of stratified purposeful sampling, intensity sampling, and maximum variation sampling.

Stratified purposeful sampling was the primary approach used to organize participants into distinct subgroups (or strata). This method involves dividing participants into categories based on key characteristics to ensure that important variations are captured (Patton, 2014). Students were first grouped according to two key criteria: the cohort they belonged to at the time of the qualitative inquiry (Grade 8 or Grade 9) and their academic outcomes following the intervention, categorized as improved (‘+’) or stagnated/worsened (‘= / -’). This resulted

in four distinct groups: Grade 8 (+), Grade 8 (= / -), Grade 9 (+), and Grade 9 (= / -). This stratification enabled meaningful comparisons both within and across different subgroups¹⁵⁶.

The categorization of academic outcomes was based on students' grades across three time points: pre-intervention (Time 1), post-intervention (Time 2), and a follow-up (Time 3). Within the performance-based strata (+ and = / -), intensity sampling was employed to select cases that provided insights into different patterns of academic change. *Intensity sampling* seeks to capture information-rich cases that represent the phenomena of interest intensely without necessarily being extreme outliers (Patton, 2014). As a result, students were initially grouped according to whether they had improved or stagnated/worsened academically. In a second step, a range of academic trajectories within these categories was further explored, capturing discrete *intensities* of improvement or decline. For example, among the students who earned better school marks post-intervention, participants included those who consistently improved across two half-terms, those who stagnated initially and then improved, and those who initially worsened but eventually improved. Similarly, in the lower-performing group, students were selected who consistently worsened, stagnated and then worsened, or initially improved but ultimately worsened. This approach provided a more accurate representation of the varied academic trajectories following the grit interventions.

The decision to use cohort as a second stratifying factor, alongside school performance, was based on several considerations. First, it was important that students were at a similar developmental stage, as younger students might have responded to or perceived the interventions differently from older students. Second, grouping students by cohort accounted for their shared experiences both inside and outside the classroom, including exposure to an identical set of core subjects, similar academic demands, and the shared impact of changes in teaching staff. Third, selecting students from the same cohort fostered a sense of familiarity and comfort within the focus groups, as participants were either classmates or knew each other from cohort-wide events.

In addition to intensity sampling, maximum variation sampling was used to ensure diversity within each stratum. *Maximum variation sampling* aims to capture a broad range of perspectives by including participants with diverse characteristics (Patton, 2014). As Morgan (1997) suggests, the focus of this approach is on minimizing sample bias rather than striving for generalizability. To achieve this, participants in each group were selected based on

¹⁵⁶ Although criterion sampling could be considered part of the approach, it is embedded within the stratified purposeful sampling, which used key criteria (cohort and academic outcomes) to form subgroups. Thus, it is not treated as a separate strategy.

carefully chosen criteria (a process referred to as segmentation), namely class membership, experimental condition, and gender. Each group included students from at least three of the six Grade 8 classes (or Grade 9 classes, respectively) and from all experimental conditions: Academic Mindsets (AM, Treatment 1), the combined intervention group (COMB, Treatment 2), and Learning Skills & Strategies (LSS, Treatment 3). Ensuring gender diversity within (and across) groups provided another layer of heterogeneity and guaranteed that the sample represented a broad spectrum of student experiences, adding depth to the analysis of the grit interventions' effects.

9.2 Sample Size

As Lopez and Whitehead (2013) note, sample size in focus group research should refer to the number of groups rather than the total number of participants across groups. The number of groups may be dictated by sampling decisions (outlined above), type of research, as well as data saturation / sufficiency considerations. Morgan (1997) advises conducting three to five focus groups to gather comprehensive data, with ideally two groups per segment (e.g., students who improved academically post-intervention) to avoid confounding the discussion content with the unique composition and dynamic of the group. Krueger and Casey (2009, as cited in Lopez & Whitehead, 2013) suggest that having five to ten participants per group is optimal for fostering meaningful interaction while maintaining a manageable data set. In line with these recommendations, each academic trajectory (+ and = / -) was represented by two focus groups, with group sizes ranging from seven to nine students.

Although data saturation could not be achieved due to restricted access to the school and its students, efforts were made to ensure data sufficiency. As noted by Shaheen et al. (2019), data collected in qualitative studies should be sufficient to allow for meaningful comparisons among selected dimensions and constructs. Additionally, Suri (2011) emphasized that data sufficiency is guided by the researcher's judgment of what constitutes enough evidence to answer the study's research questions. In the current study, the data collected were sufficient to permit a detailed analysis of the intervention's effects across different academic trajectories and contexts, despite the limitations in access.

9.3 Method of Data Collection

Focus groups were chosen over one-on-one interviews due to several key advantages. One notable benefit of focus groups is that they can be less intimidating than individual interviews, particularly for younger participants or those who may feel uncomfortable in a more formal interview setting (Lopez & Whitehead, 2013). The interaction between group members encourages participants to articulate ideas they may not express in isolation,

fostering a supportive environment for discussion and the emergence of shared experiences (Breen, 2006). Aside from being respondent-friendly, focus groups are efficient in terms of producing concentrated amounts of data on the topic of interest and are typically more economical than conducting individual interviews (Morgan, 1997). While individual interviews may explore certain issues more deeply, focus groups tend to offer a broader range of perspectives, which was important for comparing the perceived impact of the interventions across the four focus groups and for understanding how students with different academic trajectories experienced and interpreted the grit interventions. Additionally, focus groups are well-suited for evaluating programs and interventions, as they can ‘put a human face’ on the results of quantitative analyses, adding depth and context to the findings (Morgan, 1997).

The interview schedule (Appendix D.2, p. 338) followed a funnel strategy (Morgan, 1997), beginning with general questions about participants’ learning habits (e.g., ‘Do you like school?’, ‘Do you enjoy learning?’, ‘How often do you study at home?’), homework (‘Do you do your homework regularly?’, ‘Which assignments do you enjoy and which do you not?’), and recent school-related developments (e.g., ‘How was the transition to the next school Grade for you?’), which helped build rapport and get participants comfortable with the discussion. As Hallas (2014) notes, *introductory questions* are designed to be easy to answer and get everyone talking, thereby fostering a sense of belonging within the group and helping participants focus on the topic.

The main section of the schedule included *key questions* regarding students’ memories and experiences with the grit interventions (e.g., ‘Off the top of your head, what do you remember from the online course(s) you attended last year?’). These questions aimed to reactivate memories of the grit content and assess which intervention elements had left a lasting impression. However, as Haubrich and Nader (2018) highlight, memory is dynamic, and retrieval is not merely a passive readout of long-term memories. When a memory is retrieved, it is pulled out of its inactive state—where it is immune to disruption—and becomes temporarily unstable and susceptible to interference. As they explain, “the same lines of evidence that support consolidation as a stabilization process after learning, also support *reconsolidation as a necessary restabilization step* [emphasis added] following a retrieval-induced destabilization” (p. 155).

To facilitate the restabilization of these memories and ensure their persistence, the central themes from each grit course were briefly revisited using a few presentation slides. These slides recapped key topics and terms, such as neuroplasticity, as well as important imagery from the interventions. Afterward, a probing technique known as ‘laddered

questioning' (Price, 2002) was employed to get participants to reflect on this content. This approach involves asking questions that are least intrusive first, for instance those about actions, followed by questions about feelings, values, or beliefs, which are deemed more invasive. Thus, students were first asked what they found interesting or enjoyable (and conversely, what they did not) about the online course(s). They were then asked whether they had applied any of the learning or goal-setting strategies after the intervention, and finally, whether they thought any of the content covered by the course(s) has changed them in some way, however small, and how. The latter part of the main section included two evaluation questions, meant to elicit specific suggestions for improving the courses' structure, content, and duration and to assess the perceived value and broader applicability of the interventions.

Each focus group session concluded with a summary provided by the moderator, who paraphrased the key points discussed and asked the participants whether the review accurately reflected their views. These *end questions* serve as a final prompt for reflection, allowing students to clarify their contributions and share any additional insights (Hallas, 2014).

Importantly, this schedule was akin to a semi-standardized interview guide, allowing the moderator to alter ad hoc the sequence of (some) questions, add probing questions to check consistency in answers, and obtain more detailed information when necessary. Moreover, the moderator had the flexibility to adapt the research instrument to the level of comprehension and articulacy of the focus group participants, establishing a conversational style that stimulates the sharing of personal experiences, opinions, and values (Patton, 2014).

9.4 Procedure

After identifying suitable participants for each focus group and confirming their previously indicated willingness to participate in follow-up discussions (noted in an assent form for the quantitative strand of the study), I created a priority list for each group based on the criteria outlined in section 9.1, making sure to include at least twice as many students as needed. The teacher serving as my contact person at the school then approached the first eight students on each list, inviting them to participate in a focus group related to the online courses they had previously attended. If any student declined, the teacher moved on to the next person on the list until each group had eight confirmed members. These prospective participants received a new informed assent form specific to the focus groups, which they were asked to read and bring to the session. The assent form (Appendix B.11, p. 329) covered topics such as voluntary participation, the right to withdraw at any time, confidentiality, anonymity, data usage and storage, and information about data protection regulations. Ultimately, the two Grade 8 focus groups (+ and = / -) consisted of seven participants each, as one student from

each group was absent on the day of the sessions. The Grade 9 groups, on the other hand, included eight (= / -) and nine (+) participants¹⁵⁷, respectively.

The focus groups took place on the school premises in early July 2020, approximately 13.5 months after the grit interventions were implemented. Students with scheduling conflicts due to class were officially excused to participate in the discussions. Each group interview lasted between 1 hour 17 minutes and 1 hour 28 minutes and was recorded digitally using two smartphones. As the moderator, I also took notes on a laptop. The discussions were conducted in German, the primary language of instruction in Bremen secondary schools.

At the beginning of each session, participants were informed of the purpose of the discussion in an honest but fairly general fashion, assured that their identities will not be disclosed, and asked for permission to audio-record the session. Signed assent forms were also collected at this point. Ground rules were established to foster a respectful and productive discussion. These included speaking one at a time, refraining from side conversations, and ensuring balanced participation so that everyone had the opportunity to contribute without any single individual dominating the discussion. If no questions arose about these rules or other procedural matters, I introduced the opening questions (already introduced on p. 214) and invited each participant to make an initial statement on the topic. This approach helps deter ‘groupthink’, a psychological phenomenon in which the desire for harmony or cohesiveness within a group leads to the suppression of dissenting opinions or even irrational decision-making (Morgan, 1997).

As Morgan (1997) points out, focus groups designed to provide input for programs (or interventions) or to assess their effectiveness—largely applicable to the current study—often rely on more structured approaches with clear interview schedules and higher moderator involvement. This characterization was true for all four focus groups, which resembled group interviews, with participants taking turns responding to questions, rather than forums in which participants engage in collective sense-making. Nonetheless, students occasionally challenged each other’s views or built upon the responses of others (e.g., “[The course] should also be shorter, as they already said”), creating synergistic effects that are often the hallmark of focus group research (Hallas, 2014). After the concluding remarks, all participants were thanked for their contributions and each received a €10 shopping voucher as compensation for their time.

9.5 Data Analysis

At the end of the data collection phase, the focus groups were transcribed verbatim

¹⁵⁷ In Grade 9 (+), I had asked the teacher to swap one student for another in order to balance out the group, but they both ended up taking part in the discussion.

(i.e., word-for-word) using the f4x automatic transcription software¹⁵⁸ to preserve all potentially significant information and the full range of analytical uses. I then carefully reviewed and corrected the transcripts by listening to the recordings at least twice. For sections that remained unclear due to low volume or mumbling, I sought the assistance of a native speaker, who listened to these segments multiple times to ensure accuracy. Since the primary focus of this research is the content of participants' responses (the *verbal* component), circumstances of speech production (e.g., environmental factors, nonverbal cues), the way in which words are spoken (the *prosodic* component, e.g., tone, pace, volume, intonation, hesitations, emphasis), or elements of *paralanguage* (e.g., audible breathing, sniffs, sighs, laughter) were not included in the final transcripts (Kowal & O'Connell, 2014).

Among the various methods for analyzing qualitative data, the 'general inductive approach' proposed by David R. Thomas (2006) was identified as the most suitable for this research. This method, commonly applied to qualitative evaluation data (e.g., health program evaluations), was chosen for several reasons. Firstly, the exploratory nature of the qualitative strand necessitated a *data-driven approach* that condenses diverse and extensive raw text data¹⁵⁹, establishes clear connections between the research objectives and the results, and enables findings to emerge from the frequent or significant categories or themes in the data (Thomas, 2006). As Braun and Clarke (2006) note when discussing a related method, inductive thematic analysis, "inductive analysis is therefore a process of coding the data *without* trying to fit it into a preexisting coding frame, or the researcher's analytic preconceptions" (p. 83).

Secondly, in deciding between the general inductive approach (which relies on inductive coding), inductive content analysis, and inductive thematic analysis, several characteristics of the raw data were considered. A key factor was the presence of text that was not directly relevant to the research objectives. For instance, while I assumed that asking participants about their extracurricular activities would reveal that students who improved academically post-intervention spent less time on hobbies and more time on learning than students who stagnated or worsened, *all* students reported devoting most of their time outside school to leisurely pursuits. Although this is an interesting finding, detailed descriptions of pastimes such as video gaming, working out, or socializing add little explanatory value to the analysis. Both inductive content analysis and inductive thematic analysis require coding of the entire dataset, even if not all segments are meaningful to the research objectives. Inductive

¹⁵⁸ For more information about this software, please see <https://f4x.audiotranskription.de/>.

¹⁵⁹ It is important to highlight, however, that coding can also serve to expand meaning rather than summarize it.

coding, however, allows a significant portion of the text to remain uncategorized if it is deemed irrelevant to the research question(s).

Secondly, in inductive coding, specific codes may be used for just one part of the dataset or even a single text fragment. Conversely, one segment of text may be coded into more than one category. As a result, this approach allows for a lower level of abstraction during data reduction, facilitating greater closeness to the original texts. In contrast, qualitative content analysis requires consistency of codes across texts, unidimensionality (each category covering only one aspect of the material), mutual exclusiveness (each unit coded only once under one category), and exhaustiveness (all parts of the material accounted for by the coding frame) (Schreier, 2014)¹⁶⁰. Thematic analysis likewise requires researchers to “work systematically through the entire data set, giving full and *equal* attention to each data item, and identify interesting aspects in the data items that may form the basis of repeated patterns (themes) across the data set” (Braun & Clarke, 2006, p. 89). Given the range and types of topics raised by the focus group participants, a more flexible approach was needed in terms of the number and types of codes used in the analytic framework.

Thirdly, both thematic analysis and qualitative content analysis impose additional constraints that either do not align with the characteristics of the focus group data or exceed the straightforward objectives of the qualitative strand in the current mixed-methods research. Specifically, the students’ neutral descriptions of their learning habits and preferences, as well as their evaluations of the grit interventions, do not lend themselves particularly well to the thematic analysis process, which emphasizes defining themes and identifying the ‘story’ that each theme tells individually and within the broader analytic narrative (Braun & Clarke, 2006). On the other hand, unlike in inductive coding, where code development and application happen simultaneously, content analysis requires these steps to be performed separately and consecutively. This means that the coding frame may no longer be adjusted during the main analysis phase. Additionally, content analysis involves segmenting the text (assigning each unit to a single category), conducting trial coding, and evaluating the final coding frame in terms of consistency and validity (Schreier, 2014). Consequently, *when it comes to the coding process*, content analysis is both too rigorous and too restrictive for the purposes of this research.

Thomas’ (2006) general inductive approach aims “to provide evaluators and other researchers analyzing qualitative data with a brief, nontechnical set of data analysis

¹⁶⁰ A small exploratory exercise on the focus group data indicated that content analysis would yield a three-tiered structure (categories, subcategories, codes), with the miscellaneous category remaining excessively large.

procedures” (p. 238). This approach involves detailed readings of raw data to identify key concepts and themes, allowing researchers to uncover both expected and unanticipated program effects. It focuses on three broad tasks common to qualitative analysis: data reduction (through inductive coding and the development of categories), data display (reporting the findings), and conclusion drawing or verification (interpreting the results). While similar to grounded theory, this method does not explicitly divide the coding process into open and axial coding and limits theory building to presenting and describing the most significant categories.

The analysis was carried out using the desktop version of the **f4** qualitative analysis software¹⁶¹ and unfolded in four steps. The first step in the process of inductive coding outlined by Thomas (2006) is the preparation of raw data files, which corresponds to the transcription process described in the beginning of this section. The concrete coding procedure (step 2) began with reading through all focus group transcripts to gain a deeper understanding of the content. This involved searching for patterns and identifying preliminary higher-level (or general) categories, which were informed by the interview schedule and evaluation aims, such as ‘school performance trajectory after the intervention’, or ‘effects of the grit courses’. This step coincides with the familiarization phase in thematic analysis.

Next, the transcripts were also read ‘horizontally’, grouping responses by question or topic. I reviewed all answers to each question across the focus groups and assigned an *in vivo* code to each segment of data relevant to the research questions (step 3). In other words, the meaning of a text segment was summarized into a ‘label’ that stayed close to the language used by the respondent. This was done by marking text segments and assigning them to emerging categories. New segments were either placed in new categories or, when applicable, added to existing ones. As the coding frame evolved, some segments were reassigned to more suitable categories or were additionally coded into a second category that had not existed yet during the initial reading.

The final step of the coding procedure (step 4) involved revising and refining the category system. This included combining codes where appropriate, grouping related codes into lower-level (specific) categories, and subsuming these categories under broader, superordinate categories that closely resembled those identified in step 2. These indexing categories “are likely to function in the same way as headings and subheadings in the chapters of a book, giving a descriptive sense of what each section of text is about” (Mason, 2002, p.

¹⁶¹ For information about the software’s functions, see <https://www.audiotranskription.de/f4/qualitative-textanalyse/>

151). The goal of the inductive coding process, according to Thomas (2006), is to develop a relatively small number of summary categories (e.g., up to eight) that encapsulate the themes most relevant to the research questions.

For this dataset, the major categories identified were ‘perspectives on school and the school system’, ‘learning and homework habits and attitudes’, ‘perceived factors influencing school progress’, ‘spontaneous recall of grit courses’, ‘reflections on the uses and effects of grit courses’, ‘evaluative feedback on grit course design’, and ‘personal reflections on learning, life, and future goals’—a category that includes meaningful statements that did not easily fit into any of the other categories. Table 9.1 (below) illustrates the coding process, translated from German into English for reporting purposes. The complete coding frame and a full coding sample for one question in one focus group (both in German), are presented in Appendices G.1 and G.2 (pp. 354-357). An abridged version of the coding frame, which outlines the top-level categories and their immediate subcategories without delving into further detail, is provided in Table 9.2 (p. 222) and will be discussed in greater depth in the Results section.

9.6 Results

To reiterate, the qualitative strand of this study aimed to explore the academic mindsets and behaviors underlying the effects of the grit interventions, as well as students’

Table 9.1

Coding Example for the Questions: Do You Like School? Do You Enjoy Learning? Why? Why not?

Quotation	Step 3 (in vivo codes)	Step 4	
		Specific categories	General categories
“Respondent 6: School in general is important, but the school system could also be improved. So that it [school] is more fun. ... I don't learn often, but because I don't have to. But I think I would enjoy it if I learned more often. Moderator: Okay. Why don't you learn often? Respondent 6: I just don't have to learn. I still get good grades without learning or without learning endlessly.” (Grade 8+, Para. 32 - 34)	School is important	Instrumental / future-oriented view of school	Perspectives on school and the school system
	School system could be improved	Constructive critique of the school system	
	Does not learn often	Low learning frequency	Learning and homework habits and attitudes
	Would enjoy learning more often (memo: active forecasting)		
	Does not have to learn	Low-effort achievement mindset	
	Gets good grades without learning		

Note. Para. = paragraph; The quotation, codes, and category names are translated from German.

evaluations of the interventions' design, relevance, and impact. Therefore, the analysis below pertains only to data relevant to these research objectives.

The results section provides a *cross-case analysis* that focuses primarily on post-intervention school performance as a stratifying factor. In other words, the views of students who improved after the grit interventions (Grade 8 (+) and Grade 9 (+)) are compared with the views of those who stagnated or worsened post-intervention (Grade 8 (= / -) and Grade 9 (= / -)¹⁶²) across the seven general categories—along with their respective subcategories—identified through inductive coding. Where meaningful differences are found between Grade 8 and Grade 9 students within or across performance strata, these are likewise discussed.

9.6.1 Perspectives on School and the School System

The 'perspectives on school and the school system' superordinate category subsumes four categories related to students' general views on school and two categories specific to the school system. Participants with an *'instrumental / future-oriented view of school'* see school as important and necessary for their future (success), particularly in relation to earning good grades, obtaining a good school-leaving certificate, and securing vocational training or university admission: "I need it for my later life" (8+), "[School is] important because you need the certificate to do an apprenticeship" (8+) or "School plays a role somehow, because if [your goal] is a certain job you want to get ... , then you need a decent school-leaving certificate" (8-). In contrast, those who view *'school as a social hub'* emphasize its relevance as a place of socialization, "It's just... getting out of the house, seeing friends, ... socializing is important" (8-), and they enjoy it "because you are with friends, you are not so bored" (9-). Participants expressing *'discontent with school'* (a category that includes finding school stressful) report not liking school because it is usually "strenuous"¹⁶³, [you have to] close your eyes and get through it" (8-), or because teachers "sometimes ... go a bit overboard with homework or exams" (9-). Despite this, a majority of respondents across focus groups expressed *'enjoyment of school'*: "To be honest, I enjoy school" (9-), "I also really like school and I am happy to be here" (9+), or "I am also satisfied with school" (9+).

When it comes to the school system, respondents' feedback was categorized into *'perceived flaws of the school system'* (with its subcategories *'tedious instruction'* and *'irrelevant subjects'*) and *'constructive critique of the school system'*, which brought together suggestions for improvement. Examples include: "What I would ... find better would be if

¹⁶² Hereafter abbreviated as 8+, 9+, 8-, and 9-

¹⁶³ The word in German is 'anstrengend', which can mean arduous, strenuous, stressful, taxing, tiring, trying, effortful, laborious, or exhausting, depending on the context.

Table 9.2*Abridged Coding Frame (Category Levels 1 and 2)*

Perspectives on school and the school system
Discontent with school
Enjoyment of school
Instrumental / future-oriented view of school
School as a social hub
Perceived flaws of the school system
Constructive critique of the school system
Learning and homework habits and attitudes
Homework strategies
Homework enjoyment
Homework completion
Homework value
Fundamental attitudes toward learning
Fondness for learning
Learning frequency
Perceived factors influencing school progress
Academic growth
Academic setbacks
Academic standstill
Spontaneous recall of grit courses
Course content
Postcards with badges
Questionnaires
Math games
Reflections on the uses and effects of grit courses
Postcards as memory tools
Effective or engaging content
Lack of notable effects
Evaluative feedback on grit course design
Positive feedback
Negative feedback
Suggestions for improvement
Personal reflections on learning, life, and future goals

Note. The initial coding was conducted in German to maintain fidelity to the data, and the category names have been translated into English for reporting purposes.

you could choose your subjects” (8+), “[School] could be improved by giving less homework” (8+), or “I would even say that it is not right for teachers to change after Grade 9 or 10. ... Because in Grade 9 [school becomes] difficult ... and then [you also have] a new teacher. I think that the school should do it in such a way that there is no change of teachers in Grades 9 and 10, because you should only concentrate on schoolwork” (9–).

When comparing students who improved post-intervention to those who did not, several notable differences emerge. Eight of the nine statements in the *‘instrumental / future-*

oriented view of school' category were made by students who performed better in school after attending the grit courses, whereas all assessments of '*school as a social hub*' (3) or '*school as stressful*' (4), and all mentions of '*tedious instruction*' (2) belonged to respondents whose grades either stagnated or declined. These findings suggest that students in the improved-performance groups tend to see school as an essential stepping-stone for their future (professional) lives. Their statements reflect both the importance they place on schooling and its necessity for achieving certain goals. These groups either do not experience school as particularly stressful or tedious, or are able to overlook these negative aspects by focusing on the broader picture. Although it is challenging to establish causality without explicit references to the interventions, the association between attending grit courses and improved performance is strongest among students with future-oriented views of school. These views may have been simply reinforced by the intervention content, particularly that of the Academic Mindsets course, or may have emerged as a result of it.

9.6.2 Learning and Homework Habits and Attitudes

The 'learning and homework habits and attitudes' top-level category encompasses three categories related to learning and four categories related to homework: 'fundamental attitudes toward learning' (subdivided into 'low-effort achievement mindset', 'learning as a necessity' and 'inherent value of learning'); 'fondness for learning' (with its subcategories 'cramming approach to learning', 'grades-driven learning', 'subject/topic-dependent learning', 'mood/motivation-dependent learning', and 'learning enjoyment'); 'learning frequency' (split into 'low learning frequency' and 'high learning frequency'); 'homework strategies'; 'homework enjoyment' (including subcategories for dislike and selective enjoyment of homework); 'homework completion' (focusing on consistent or inconsistent completion); and 'homework value'.

Students with a '*low-effort achievement mindset*' report being able to earn good grades without having to learn at home: "I've been lucky. For me, it's enough if I just listen in class and do my homework. And I still manage to keep my grades reasonably good" (8-). Respondents who see '*learning as a necessity*', on the other hand, appear to approach school education with a sense of obligation: "You don't have to like everything to do it, ... sometimes you [just] have to do it" (8+); "Everyone is pressured to learn because it is important" (8+); or "When it comes to school, I always force myself through the topic, even if I don't like it" (9+). Those who see the '*inherent value of learning*' state that, "in general, learning is always good. You always have to learn new things" (8-), and one participant admitted: "I like coming [to school] because I love learning new things ... all the topics ...

expanding my self-knowledge” (9–).

In the ‘fondness for learning’ category, most students report a ‘*cramming approach to learning*’, meaning they only study for tests and exams, as illustrated by statements like “Oh, how often do I learn? I always learn the day before an exam (9+)” or “I only study when I have to write an exam or a test” (8–). Similarly, a majority of participants either do not enjoy learning (e.g., “Do I like learning? I don’t think so. I don’t think any of us likes learning” (8+)), exhibit ‘*subject/topic-dependent learning*’, or, to a lesser extent ‘*mood/motivation-dependent learning*’: “Do I enjoy learning? That always varies. Which topic? Which subject?” (9–); “With learning, [it’s] just like [for] everyone else. It depends on the subject whether I have motivation” (9+); “I learn when I want. So, when I feel like it, I learn. When I don’t feel like it, I don’t learn” (8–). Only four students out of 31 generally enjoy learning, and two students displayed ‘*grades-oriented learning*’, echoing the sentiments from the ‘learning as a necessity’ category: “I actually always learn, even when I don’t feel like it, because I can then improve my grade point average” (9+); and “I learn so that I can get good grades and [because] I also need to graduate” (9+).

Unlike ‘learning frequency’, where only some students report studying regularly, most participants complete their homework consistently, regardless of cohort or post-intervention school performance. This consistency is linked to both a perception that homework is not optional and the fact that it is oftentimes grade-relevant: “You just have to do it, otherwise the teachers give you bad grades” (9+). However, only two students report enjoying homework regardless of subject, while the majority either dislikes it or only enjoys it selectively, depending on the subject or type of assignment.

The comparison between students whose grades improved after the intervention and those whose grades stagnated or declined reveals meaningful differences in ‘learning and homework habits and attitudes’. Only students from the improved-groups expressed views that fell into the ‘learning as a necessity’ (4) and ‘grades-oriented learning’ (2) subcategories, reflecting a more *instrumental view of learning*. This perspective frames learning primarily as a means to an end, where the motivation to learn is often extrinsic, focused on practical outcomes, rather than intrinsic, focused on the value of gaining knowledge. Viewing learning as necessary mirrors, to some extent, the instrumental / future-oriented perspective on school held by the same groups.

A second noteworthy difference was in the subcategory ‘*high learning frequency*’, where seven out of nine responses belonged to students in the groups that improved post-intervention (8+ and 9+). This finding suggests that learning at home is one of the academic

behaviors that translates into better school performance. In the subcategory *'homework value'*, only students from the improved groups reflect on the importance of doing homework both for understanding the topics and for maintaining one's grades¹⁶⁴: "I think that homework has to be done. It doesn't matter in which subject, because it's also a type of repetition. If you don't do it, this will be recorded and it will also affect your oral grade" (8+); or "I do my homework most of the time. It is also important for understanding the topic better" (8+). Furthermore, students from the groups that stagnated or worsened post-intervention are overrepresented in the subcategory *'inconsistent homework completion'* (5 vs. 2), which includes statements such as "I do homework when I can remember what I have" (9-) and "I hardly ever do my homework because I don't really feel like doing it" (9-). Thus, being aware of the significance of homework both for comprehension (intrinsic value) and for grades (instrumental value) and doing one's homework consistently appear to be an attitude / behavior combination associated with improved academic performance. Taken together, these insights align with findings from the quantitative strand indicating that school engagement—represented here by learning at home and doing one's homework regularly—acts as a mediator between grit (or the grit interventions) and improved GPA.

9.6.3 Perceived Factors Influencing School Progress

Within the 'perceived factors influencing school progress' superordinate category, students' reports of their school performance post-intervention are classified into three main categories: 'academic growth' (with subcategories like 'increased effort and school engagement' or 'supportive environment'), 'academic setbacks' (with subcategories such as 'increased academic pressure and demands', 'decreased effort', or 'unsupportive environment'), and 'academic standstill'.

Focus group participants were asked to reflect on their transition between two school years—the first school term in Grade 8/9 also being the first term following the intervention—without being required to explicitly link their academic progress (or lack thereof) to the grit courses. This neutral approach served two purposes: first, to identify attitudes and behaviors that may have contributed to academic improvement, and second, to assess whether students spontaneously referenced any potential intervention effects. Moreover, this question provided a check on the stratified sampling procedure, confirming that the majority of students in each performance stratum reported academic outcomes consistent with their assigned group: 14 out of 16 in the improved groups noted academic

¹⁶⁴ Five of the seven text segments coded into this category belong to the improved groups.

improvement (with two reporting a performance plateau), while 14 out of 15 in the stagnated / declined groups reported a lack of progress or a worsening of their school performance.

In the *'supportive environment'* subcategory, three participants attributed their academic progress to teaching staff changes, noting that effective teaching played a critical role. One student remarked, "We changed teachers very often and that obviously makes a difference. For me, it definitely makes a difference because there are some teachers who can explain things well and some teachers who can't explain things so well" (8+). Another student credited her progress to her mother's impetus: "I think it's because I have a very strict mother. If she weren't there, I think I would have messed up at school. She made me study a lot" (8+).

All remaining perceived reasons for improvement (6) were categorized under *'increased effort and school engagement'*. This subcategory includes statements like "In Grade 7, I was absent a lot. I mostly didn't do my homework or I forgot it very often, and that's why I've started to study more now" (8+), and "Most of it happened because I started to speak up more in class. In other words, to participate more" (9+). Another student reflected, "I really tried hard because I saw that Grade 9 is important. I have also completed an advanced course. Now I have my intermediate school-leaving certificate, and I am trying to get another advanced course so that I can do my Abitur" (9+). One participant in this group suggested that in addition to putting in more effort, the topics in some subjects may have become easier.

Overall, although none of the participants explicitly referenced the online grit courses, the primary factors contributing to their academic progress were more frequent learning at home, greater engagement at school (e.g., improved attendance, consistent homework completion, active class participation), and, to a lesser extent, a supportive environment. These findings align with the hypothesis that specific academic behaviors, such as increased school engagement, contribute to improved outcomes. These effects may have been driven either by students' pre-existing learning motivation or (school) grit, or by the influence of the grit course content, which specifically aimed to cultivate positive academic mindsets and equip students with effective learning strategies.

In the groups that experienced stagnation or decline after the intervention, students attributed their academic struggles or lack of progress to decreased effort, changes in teaching staff, and increased academic pressures and demands *in equal measure*. Some students reported learning less, being distracted, or not realizing that school "gets more serious" in the higher Grades. Illustrative comments include: "I learned less" (9-); "I also learned relatively little and was distracted" (9-); "I didn't even realize that things were getting more serious,

which is why I didn't put much effort into school" (9-); or "I think that none of us try that hard in the first term because we think, okay, we'll do better in the next term" (9-).

Among those who expressed dissatisfaction with having new teachers, some criticized the way these teachers explained the material or graded assessments, while others highlighted the difficulty of adjusting to new teaching styles. Additionally, several students felt that the new teachers had expectations that were too high, a sentiment closely linked to the subcategory 'increased academic pressure and demands': "With the other teacher, [I had] better grades and he could teach better than the current one" (8-); "[I did worse] because I don't like some teachers, or they grade too strictly, like my new teacher" (8-); "Our class teacher went on parental leave and then we had [a new Math teacher] and you just couldn't get used to his lessons, because he taught differently from our old teacher. Our German teacher has also changed ... and then you have to get used to how she teaches it. This made our grades a little worse" (9-); or "It was also because we had a new teacher. He simply had too high expectations of us" (9-).

Finally, students acknowledged that they struggled in school due to heightened pressure and academic demands, as reflected in the following excerpts: "There was a big increase in demands, assignments, and everything ... but I'm slowly getting better at it" (8-); "[My grades declined] because the topics have often become much harder" (9-); "[In] the transition from Grade 8 to Grade 9, you could already tell that it was getting harder" (9-); or "When she first came to us, she gave us worksheets about what we had to do to get our grade. And I thought the expectations were very, very high" (9-).

When considering both the factors that facilitated students' academic progress and those responsible for performance stagnation or decline, it is important to note that personal effort—evidenced by increased school engagement—seems to play a more critical role in fostering growth than its absence does in contributing to decline. Other influences, such as an unsupportive environment (e.g., frequent teacher changes, inadequate instruction) or increased pressure and demands misaligned with students' personal or academic development, appear to be at least as significant in contributing to poor academic outcomes as a lack of personal effort. This suggests that academic growth is primarily self-driven, whereas setbacks are the result of multiple interacting factors.

In the school context, these findings suggest that academic success is multifaceted, requiring not only individual motivation but also balanced expectations, suitable challenges, and a stable, supportive learning environment. When external factors such as poor teaching, frequent teacher changes, or an overburdening curriculum arise, the absence of personal effort

amplifies these challenges, resulting in more substantial setbacks than lack of effort alone would cause. This underscores that educational progress is shaped by both individual and systemic factors, with decline occurring when personal and environmental elements fail to align in the student's favor.

9.6.4 Spontaneous Recall of Grit Courses

The 'spontaneous recall of grit courses' general category includes subcategories related to the main elements of the grit interventions, namely the 'questionnaires', 'math games', 'postcards with badges' and '*course content*'. The latter is further divided into topics recalled by focus group participants, such as 'goal-setting', 'thinking about the future', 'improving in school', 'learning and concentration strategies', 'student statements', 'brain / neuroplasticity' and 'videos'.

The most remarkable finding related to this category is that many students across all focus groups were able to recall a substantial number of intervention elements, describing several of them in considerable detail. For instance, one student commented, "I also know that the brain can continue to learn. So you can become smarter, so to speak, because the more often you learn something, the more often these nerves are used and the stronger the nerve pathways become" (8-)¹⁶⁵. Another participant noted, "I can still remember a trick where you had to remove all things from a room that could distract you" (9+)¹⁶⁶. The fact that students were able to remember these details accurately after nearly 14 months, despite the brevity of the grit courses, demonstrates the lasting impression that a one-time intervention can leave.

Notably, the groups of students with differing academic trajectories did not vary substantially in their spontaneous recollections of the grit courses. Of the 32 coded text segments in this category, 18 were attributed to the improved-group students. While these participants recalled more strategies related to learning, concentration, and goal-setting from the LSS intervention (including an animated video on the consequences of bad habits), students whose performance either stagnated or declined post-intervention recalled more information related to brain functioning, the postcards, and the self-selected goals portion of the pre- and post-intervention questionnaire.

These findings raise important questions about the mechanisms through which the interventions may have affected academic performance and suggest that factors beyond mere recollection play a crucial role. Remembering content is different from applying it in meaningful ways. Both groups may have retained similar amounts of information, but the

¹⁶⁵ This content was at the basis of the growth mindset module in the Academic Mindsets course.

¹⁶⁶ This strategy was part of the deliberate practice module in the Learning Skills & Strategies course.

students who improved might have been more successful in applying the grit principles in their academic work. Factors such as motivation, self-regulation, contextual influences, psychological readiness, or cognitive overload may explain why some students improved while others did not, and will be addressed in more depth in the discussion section.

9.6.5 Reflections on the Uses and Effects of Grit Courses

The top-level category ‘reflections on the uses and effects of the grit courses’ serves as a broad umbrella, capturing insights relevant to multiple research questions across both the quantitative and qualitative strands of this study. This includes RQ 3c, 3d, and 3e from the quantitative strand (“How do the interventions affect c) school engagement, d) personal and academic goals, and e) students’ GPA over time?”), as well as RQ 4 (“Which is the most effective grit intervention?”). In the qualitative strand, it is relevant primarily to RQ 7.

This category is subdivided into three distinct areas: ‘postcards as memory tools’, ‘lack of notable effects’, and a very broad category titled *‘effective or engaging content’*. The latter encompasses various subcategories for types of content that resonated with the students, e.g., ‘thoughts about the future’, ‘brain functioning (neuroplasticity)’, or the ‘WOOP method’. Before delving into these themes, it is useful to examine first how frequently students from different focus groups referenced content they found useful or engaging (Table 9.3, p. 230).

Engagement Patterns by Academic Trajectory. The substantial difference in the number of references to impactful or interesting content between students who improved (27 text passages) and those who stagnated or declined (12 passages) serves as an important indicator of the interventions’ effects. While both groups initially recalled a similar number of aspects from the interventions, the improved students showed greater depth of engagement when reflecting on what they found interesting, what they applied in their lives, and whether the courses had made a difference. This richer feedback suggests that the interventions may have resonated more profoundly with the improved students, facilitating not only their understanding but also their ability to integrate and apply the concepts presented. The following excerpt illustrates this point: “I find it good that we were asked questions about the future; I think it’s beneficial because it encourages you to reflect. ... Before the course, I hadn’t considered my plans for the future. But when [I learned] about our brain and how success is achieved, I became more aware of what I was doing, why I was doing it, and what I wanted. I thought the questions were very good” (8+).

Even among students who, earlier in the focus group discussion, attributed their academic improvement to factors such as changing teachers or studying harder—without directly linking their achievement to the grit courses—their reflections on the course content

Table 9.3

Frequency of Text Passages Assigned to Codes in the ‘Reflections on the Uses and Effects of Grit Courses Category’

Intervention elements / themes	Grade 8 (+)	Grade 9 (+)	Grade 8 (=/-)	Grade 9 (=/-)	<i>Passages in the code</i>
Postcards as memory tools	3	1	1	1	6
Thoughts about the future	3	-	-	-	3
Brain (neuroplasticity)	2	2	-	2	6
Success through effort	4	1	1	-	6
You can learn everything	1	-	-	-	1
WOOP method	3	2	-	2	7
Positive goals	1	-	-	-	1
Deliberate practice	1	-	1	1	3
Becoming successful	-	2	-	3	5
Self-selected goals	-	1	-	-	1
<i>Passages in the text</i>	18	9	3	9	39

Note. Each code counts separately. Only passages that are assigned to the selected code are counted.

suggest that the interventions may have influenced their attitudes and approaches to learning. For instance, one Grade 9 student who reported having “gotten a lot better” after the intervention because she “also got new teachers during that time” and “learned a little more in Math than usual, but not much more in the other subjects”, reflected on content from the growth mindset module in the Academic Mindsets course: “I found the information about the brain interesting: that you can learn new things even if you don’t know them very well at first, but you nonetheless just keep at it” (9+).

Interestingly, the only two students who noted that the interventions did not affect them in any way—coded into the subcategory *‘lack of notable effects’*—also belonged to one of the improved groups. One remarked, “It didn’t bring about any change for me” (9+) while another said, “I changed almost nothing because I already knew a few things and had already done them before” (9+). Although the strategies taught in the course were already familiar to this student, this does not necessarily diminish the content’s value or effectiveness for others.

Engagement Patterns by Cohort. In general, certain types of content resonated particularly with Grade 8 students, such as the growth mindset video (AM), setting positive goals (LSS), and reflections on the future (AM / LSS), while other content, like the ‘success iceberg’ animation (AM), shown below (Figure 9.1, p. 232), had greater appeal for Grade 9

students. Certain modules (e.g., the WOOP method, John Legend's video, and information about the brain and neuroplasticity) were popular across both cohorts and academic trajectories, garnering the most mentions and praise and demonstrating their broad applicability in grit-focused interventions.

An intriguing finding is that Grade 8 students who improved after the intervention stood out in their engagement with the grit course content. They referenced and discussed intervention elements that appealed to them twice as often as students in either of the Grade 9 focus groups, and *six times* as often as Grade 8 students who stagnated or worsened post-intervention. This difference is not only evident in the number of mentions but also in the richness of data, which is a more meaningful indicator in qualitative research. For instance, one Grade 8 student reminisced about a growth mindset-focused video titled 'You can learn everything': "When I watched the video and understood that you need a lot of patience to study and that you also invest a lot of time in it, I realized that I want to get my Abitur, and that I have to build up my patience to actually do that" (8+). Another student from this group commented on the 'success through effort' video featuring U.S. artist John Legend: "The video with John Legend gave me motivation to get a better school-leaving certificate" (8+).

Contributions related to 'thoughts about the future' were particularly poignant: "I believe [what changed] was thinking about the future, because these thoughts came then all of a sudden¹⁶⁷. So personally, this helped me a lot to learn better in some subjects" (8+). Another student expanded on this thought: "It was the same for me, I didn't learn that much before, but then I started thinking about learning more, because it would be more beneficial for me in life if I learned more, rather than learning nothing at all; because then I wouldn't have a degree and wouldn't be able to find a job ..." (8+). Equally powerful were students' thoughts on John Legend's 'success through effort' video: "I found it interesting to see how [someone] was at the very bottom and then managed to improve. And anyone could actually do that if they learn a lot and decide what they want to be or do. So this motivates you to do more" (8+). This remark encouraged another student to share: "It's the same for me. At first, I thought I wouldn't be able to graduate. And then I saw the video and thought, yes, I'm sure I'll manage if I study more and ... also get good grades" (8+). This engagement with forward-looking content suggests that this cohort may be at a developmental stage where future-oriented thinking, including identity formation and long-term goal-setting, is rather salient.

¹⁶⁷ An alternative translation would be "these thoughts came then all at once". The original phrasing in German was "da diese Gedanken kamen dann auf Einmal".

Figure 9.1*The Success Iceberg*

Note. Erfolg = success; Was Leute sehen = what people see; Was Leute nicht sehen = what people don't see; Leidenschaft = passion, dedication; Enttäuschung = disappointment; Fehler und Scheitern = mistakes and failures; Harte Arbeit und Aufwand = hard work and effort; Ausdauer = endurance, perseverance; Gute Gewohnheiten = good habits; Verzicht = sacrifice.

Grade 9 students, on the other hand, responded more strongly to metaphors like the success iceberg (pictured above), which highlights the unseen efforts required for success. This difference may reflect a growing awareness of the significance of effort and persistence as students approach the end of their compulsory schooling: "I found the part about the brain and the iceberg very interesting. Especially the part about the iceberg, which shows everything you actually have to do to be truly successful" (9+). A student from the other group reflected: "I thought it was really nice that it was shown that you can't be successful just like that. And I saw for myself afterwards that I have to work hard or generally do things to make it happen and that you can't be successful straight away. So I liked this part the most" (9-). Building on this, another participant added: "I also thought it was nice to learn that success doesn't just come, that you have to work hard for it and that you also need perseverance and everything else ... for it" (9-).

The module focused on the WOOP motivational goal-setting strategy (Wish, Outcome, Obstacle, Plan), developed by German academic Gabriele Oettingen and researched under the scientific term Mental Contrasting with Implementation Intentions (MCII), resonated with students across both cohorts and academic trajectories. One participant

appreciated that the exercise was completed in class, saying “I found this WOOP [strategy] very interesting: you learn step by step how to achieve your goal. I also thought it was good that you didn’t have to think about it at home, you could enter the goals directly there, during the online course” (9–). Students reported finding this method “helpful” and using it to set both school-related goals (“I set goals for any subject so that I can earn good grades” (8+)), and personal goals (“I thought the WOOP method was good, I filled out [the card] and then achieved my goal this way” (9+)).

Last but not least, while some students admitted to discarding shortly after the intervention the postcards with the badges they earned during the online course(s), six participants across the focus groups shared that the postcards served as helpful reminders of the course content: “I didn’t really think about it that much, but whenever I had this card in my hand while cleaning up, I remembered ... what I had actually forgotten” (9+). One student even described feeling motivated by the card: “Yes, I have it. I put it on my desk afterwards. And then I wanted to study for an assignment, so I looked at it again. I don’t remember now exactly what it said, but after [seeing it], I felt a bit motivated because I knew, okay, if I learn this now, I’ll get a good grade, and that happened automatically for me” (9–).

Impact on Students Who Stagnated or Declined. Although students who stagnated or declined academically referenced fewer course topics they found thought-provoking, several still reflected on the course content and its influence in meaningful ways. For instance, one participant reported feeling motivated by the brain and neuroplasticity-focused part of the growth mindset module: “I thought it was good that we learned that the brain is just a muscle ... and that it changes. And ... I felt a bit more motivated afterwards” (9–). Another participant in the same group shared that she was able to quiet her self-critical voice: “After the course, I noticed: OK, you put too much pressure or strain on your brain. It *does* learn what you want it to learn, but over time. So I personally learned [that] I have to give my brain a bit of time so that it can understand [things], and I no longer pushed so hard, ‘*I can’t do this. I can’t do it*’, but I gave myself time instead” (9–). Another student recalled using the WOOP method to reach a personal goal: “I had set myself the goal of playing more basketball. And ... after [the course], I was fully motivated and said to myself, okay, you have to do this now, otherwise you won’t reach your goal. And I did reach my goal! But after that, it wasn’t possible anymore because of the coach, but that’s another story, it wasn’t my fault. But it [the WOOP method] definitely made a difference” (9–). Finally, in reference to the ‘success through effort’ content, one student admitted that his motivation, sparked by said content, was short-lived: “I felt a bit more motivated afterwards ... but that went away after a few days.

But I was more motivated and did a bit more because I knew that success doesn't just come like that" (9–). The issue of fleeting effects will be explored further in section 9.6.6, which focuses on students' suggestions for improvement.

Broader Observations. The results from the 'Reflections on the Uses and Effects of Grit Courses' section provide critical insights into how students perceived and engaged with the grit intervention content. While the grit courses may not have led to academic improvement across the board, participants' reflections suggest that the interventions did influence their attitudes toward learning and self-improvement. It is particularly striking that students not only remembered the content a year after the intervention but also connected it to their own experiences and future aspirations. Specific modules from both the Academic Mindsets and the Learning Skills & Strategies interventions appear to have bolstered participants' belief in their ability to improve through effort and perseverance, a core message of any grit-focused content. This nuanced understanding—that even students who did not experience academic improvement may have still benefitted in other ways—is crucial for evaluating the broader effects of the grit interventions.

The findings also speak directly to the research questions outlined in the beginning of this section. Students reported applying aspects of the grit content and experiencing successes in both academic and personal contexts, indicating that the interventions may have contributed to increased school engagement (RQ 3c), improved grades (RQ 3e), and the achievement of self-selected personal and school goals (RQ 3d) over time. Modules focused on growth mindset (from the AM course) and goal-setting (from the LSS course) were particularly well-received, with a slight preference for the motivational video content in the AM course (RQ 4). Future-oriented thinking, the belief that 'I can improve' (growth mindset), and a core grit tenet ('success through effort') are the mindsets that resonated most with the students, while committing to a goal, working hard(er), having patience, being perseverant, and investing time in certain endeavors were identified as key behaviors contributing to (academic) improvement (RQ 7).

9.6.6 Evaluative Feedback on Grit Course Design

The general category 'evaluative feedback on grit course design' encompasses students' 'positive feedback', 'negative feedback' and 'suggestions for improvement'.

Students from both cohorts provided '*positive feedback*' in equal measure, with some remarks applying to both grit courses (4) and others directed primarily at the AM course (12) or the LSS course (8). Several students expressed that they found the grit courses "good" and could not recall any negative aspects or elements they did not enjoy. One student clarified that

the value of the content depended on the student's level of commitment: "If you really want to put your mind to it and if you take it seriously, you could learn something" (9+). Others appreciated the novelty of participating in an online course outside of their usual school routine. One student noted, "It was just something different" (8-), while another one shared, "I often wanted variety in my everyday life, not always going to school and then home to play video games, eat, do sports. ... Even if it wasn't much, even if it's partly related to school, it was just something completely different that I could recommend to others" (8-). A third student remarked, "I thought it was a nice experience to do something like that and I would really recommend it to others" (9-).

In addition, several participants mentioned specific course elements they particularly enjoyed or found interesting, such as the WOOP goal-setting strategy (5), John Legend's 'success through effort' video (2), the success iceberg animation (1), the animated brain figure explaining the content in the AM course (1), and different learning strategies (1). Lastly, some students provided positive feedback regarding the courses' design, structure, or length: "I think it's cool how there were always videos and examples for all the tasks or quizzes" (8-); "I really liked the structure ... because everything was illustrated or [had] videos, it was easier to understand than [having the information] just in the text (8-); or "I liked the length of the course" (8-).

Although only five statements were categorized as '*negative feedback*', it is notable that both courses were considered "too long" by some students, which made it difficult for them to concentrate or caused them to feel they were losing "far too much teaching time" (9+). One student described the John Legend video as "a bit boring", while another felt that a video featuring student interviews was "too long". Regarding the Academic Mindsets course, one participant remarked, "I actually found it a bit unnecessary because most of the time the children weren't concentrating on it anyway. They mostly didn't participate" (9+). This sentiment aligns with this student's earlier comment that the course content is only valuable to those who are motivated to engage with it.

In the subcategory '*suggestions for improvement*', about a quarter of all comments focused on the perceived advantage of shortening the courses to "maybe 30 or 25 minutes" to help maintain interest and prevent distraction. One student suggested this approach would be beneficial because "our brain remembers shorter things much better than longer things" (9+). Additional feedback regarding the courses' delivery format or design included

recommendations to use convertible notebooks¹⁶⁸ instead of PCs, to incorporate “more videos and images and less text” (8–), or to transfer parts of the grit courses to an “offline” setting. The latter suggestion stemmed from concerns about prolonged screen time, which some students noted could strain the eyes and reduce concentration.

In relation to this last point, two students suggested that it would be beneficial to discuss these topics in class, both with teachers and other students, while a third remarked that the course content “would need to be constantly refreshed or there should really be a postcard somewhere in sight so that it stays in your head. [It’s not enough] if you only hear it once. It probably doesn’t have to be quite as long when you refresh it” (8–). When asked whether they can imagine this content being part of the school’s teaching concept, some participants shared ideas for embedding it at the beginning of the school term and before exams, “so that we are always reminded that we have to work hard to be successful” (9–), which “would motivate me to reach by goal and not be distracted” (8–). One participant suggested that this would allow students to “repeat it more and work their way into it more” (9+), while another noted that “if the teachers know most students have difficulties in a specific subject, I think it would be better if a video was played with examples on how they can learn better and plan [their learning] more strategically” (8+).

Hence, integrating the content of the grit courses into the regular school curriculum could offer several advantages over a one-time psychological intervention carried out by researchers. While the latter offers an initial spark of motivation or insight, it lacks the sustained support, context, and repetition necessary for long-term behavioral change. By embedding key grit principles into the daily school experience, students are more likely to internalize and apply them, enhancing both their academic and personal development—a line of thinking further explored in the discussion section of this chapter.

Students also provided feedback regarding the timing and organization of the grit courses. For instance, one participant felt that the courses were well-suited for students from Grade 7 or 8 onward, as this is when “school gets more serious” (8+). However, others suggested that the content could be adapted for both younger and older students. One student believed elementary school children could benefit from a simplified version, focusing on the message that “they can learn anything” (8–). Meanwhile, another participant proposed offering the courses to 9th- and 10th-graders but with additional content related to career exploration, helping students “know which direction [they] should go in” (8+). Additionally,

¹⁶⁸ Convertible notebooks offer two devices in one: a laptop with a classic keyboard and a tablet with a touchscreen.

there were concerns about group dynamics, with some students suggesting that the courses should be offered only to those genuinely interested, to avoid distractions caused by disengaged peers, who “just mess around or make faces” (9–). One student suggested that announcing the shopping vouchers¹⁶⁹ in advance had unintentionally attracted students who participated for the potential reward, rather than out of genuine interest in the topic, and recommended that such incentives be mentioned only after participation.

Finally, focus group participants widely expressed that they would recommend the grit courses to others, offering various reasons for their endorsements. One student remarked, “I would recommend it to people who have no motivation and who are willing to learn new things” (9–), while another noted, “I would also recommend it to people who don’t know exactly what their goals are or how they can achieve them” (9–). Some students highlighted the courses’ relevance to future planning and self-reflection: “I would recommend it to someone because it raises very important questions about your future or why you are not learning” (8+); or “I would recommend this course to other people so that they can get a bit of motivation and get to know themselves a bit better” (8–). Overall, students appreciated the grit courses for enhancing motivation and providing practical learning and goal-setting strategies, with some simply concluding, “I would recommend it to *every* student” (8+) or “I would really recommend it. I thought it was nice” (9–).

In conclusion, the answer to RQ 8, “How do students evaluate the grit interventions?” is multilayered. Overall, students evaluated the grit courses positively, highlighting their engaging content, interactive format, and practical strategies for learning and goal-setting. Many participants also emphasized the courses’ potential to foster motivation, self-awareness, and future planning. The novelty of the courses and the break from typical school routines were particularly appreciated, with many students expressing that they would recommend them to others. However, participants also provided constructive criticism, especially regarding the length of the sessions, with several suggesting that shortening the courses could improve focus and retention. Additionally, some students recommended integrating grit principles into the regular school curriculum, which would enhance their relevance, deepen understanding, and provide ongoing reinforcement.

9.6.7 Personal Reflections on Learning, Life, and Future Goals

The set of reflections in this final category—belonging mostly to students who stagnated or worsened academically after the intervention—showcases a tension between

¹⁶⁹ Three €10 shopping vouchers were awarded to course participants through a lottery system.

intention and action, as students grapple with balancing their desire to take control of their learning with the pressures of meeting school requirements and planning for their future. Many express an awareness of the need to study or improve academically but struggle to translate this into consistent effort or action. For example, several students acknowledge that they had plans to study more but continually postponed those efforts, hoping instead to improve in higher Grades.

There is also a marked ambivalence toward school-related goals, with some students prioritizing personal interests over academic success. For instance, one student admits that “getting better at school” is “not necessarily” a goal of his, while another notes that the common assumption that everyone learns more before a test or exam does not apply to him. This perspective aligns with the sentiment that not all learning occurs within the classroom; some students place equal value on life experiences, sports, and social interactions as contributors to their personal growth. While one participant reflects on the significant role school plays in shaping students’ future, particularly in relation to career goals or finding happiness—“because school is kind of the biggest part of our lives [right now]” (8–)—another participant adds that this “doesn’t mean that you have to get better at school to achieve your goals. But ... that often helps” (8–).

The reflections also reveal a sense of resignation or uncertainty about the future, with students acknowledging that life rarely unfolds as planned. One student shares, “I don’t have a plan for how my life should go ... because something always comes up that could get in the way” (8–), while another states, “I just go through life ... to see what happens” (8–). In contrast to students from the improved groups, who often adopt an instrumental or future-oriented view of school and learning, seeing the achievement of certain school goals as a matter of course, students who did not improve academically after the intervention tend to exhibit a reduced desire to set and achieve goals. Their motivation appears tentative—they understand, in theory, the importance of doing well in school, but struggle to connect this awareness with steps that could help them reach specific goals, both in school and beyond.

9.7 Discussion

The analysis of the superordinate categories ‘perspectives on school and the school system’ and ‘learning and homework habits and attitudes’ revealed that students who improved academically after the grit interventions commonly exhibited an *instrumental / future-oriented view of school and learning*. This mindset, characterized by recognizing learning activities as essential, manifested in behaviors such as increased learning frequency and consistent homework completion. Students in the improved groups often highlighted the

significance of school for achieving future goals, including access to vocational training or higher education, which aligns with the core messages of the grit interventions. This suggests that the content of the grit courses may have reinforced or even fostered these (beneficial) attitudes. Similar patterns are evident in the work of Yukhymenko-Lescroart et al. (2023), who found that a career-focused purpose orientation—a sense of purpose tied to achieving future career success—predicted grit-perseverance above and beyond the general sense of purpose in life. Like the improved students in the present study, those with a career-focused purpose orientation reported greater levels of flourishing and perseverance of effort, confirming the connection between an instrumental perspective on school and learning and gritty behaviors. Collectively, these findings point to a correlation between a future-oriented perspective, higher engagement in beneficial behaviors, and improved school performance.

This instrumental view of school and learning corresponds to the attainment and utility values described in value theory, which emphasize the *importance* of achieving specific school outcomes and the *practical benefits* of education. However, it aligns less with intrinsic value, which reflects a genuine interest in and enjoyment of the learning process itself. This distinction raises an interesting tension with Dweck's (2014) argument that intrinsic motivation and mastery-oriented (learning) goals are key factors in academic tenacity and academic achievement. At the same time, education systems often reinforce instrumental perspectives. By emphasizing grades and other measurable outcomes¹⁷⁰, they create a fertile environment for an outcome-driven mindset. Students who adopt this mindset frequently do well because they focus on what the system rewards—strategic learning behaviors geared toward success in exams or assignments. This goal-oriented behavior, often seen in gritty individuals, enables students with an instrumental view of learning to thrive, as their motivation stems from the awareness that their efforts have a clear and tangible outcome, such as good grades. Furthermore, societal and parental pressures to perform academically push students toward an outcome-driven approach that prioritizes achievement and efficiency over intrinsic learning and curiosity.

However, the downside of an instrumental mindset is that the emphasis on mastering material for assessments leaves little room for activities that foster a meaningful engagement with the material. While grit presupposes *passion* and perseverance for long-term goals, certain steps in the achievement of personally significant goals—such as doing well in school—may be treated as purely instrumental. Success in such steps would still be seen as a

¹⁷⁰ For instance, the number of advanced courses a secondary school student has passed, which is an eligibility requirement for the Abitur track in comprehensive secondary schools in Germany.

marker of (school) grit, regardless of students' enjoyment of the subject matter.

Ultimately, an instrumental view of learning, partially strengthened by gritty behaviors such as goal-setting and deliberate practice, is neither inherently positive *nor* negative. A gritty student who has learned to navigate the traditional education system may leverage a strong school-leaving certificate to pursue various meaningful goals after graduation. In contrast, a student with an intrinsic view of learning—driven by curiosity, personal growth, and the love of knowledge—might find herself constrained by the rigid structure of the same system that is meant to nurture her development. Furthermore, it might be misguided to expect adolescents to enjoy learning and maintain intrinsic motivation within a school system that fails to prepare them with the essential knowledge and skills needed for today's job market. Indeed, findings from a representative survey conducted by the Forsa Institute on behalf of the RedaktionsNetzwerk Deutschland (RND) indicate that 85% of German citizens believe that graduates are not adequately prepared for life after school (Geyer, 2023).

One of the most remarkable outcomes of the grit interventions—captured by the category 'spontaneous recall of grit courses'—was witnessing the extent to which students remembered specific content from the courses, more than a year after they had participated. This finding goes beyond the quantifiable outcomes typically used to assess intervention effectiveness, offering a different dimension of impact: the ability to leave a lasting cognitive imprint. It is a testament to the notion that a single, brief intervention can plant a seed that remains with learners long after the formal experience has ended. For me as a researcher, this finding is as meaningful as any quantifiable effects on school performance and goal achievement captured in the quantitative strand of this study.

From a memory science perspective, this long-term retention signifies the successful transition of the course content from short-term to long-term memory, a process that requires initial engagement with the material (attention), encoding (processing the information), repeated neural activation (reinforcement of neural pathways), consolidation (stabilizing and storing the memory long-term), and subsequent neural integration (linking new information with existing knowledge to form a coherent and interconnected memory network) (Cowan et al., 2021). From a psycho-pedagogical perspective, this reflects the potential of educational interventions to transcend immediate outcomes, reaffirming that my presence in the school and the research effort itself were not in vain but had real-life consequences, however small.

The difference in the behavioral application of the content between students who improved post-intervention and those who did not may stem from the improved groups having a stronger (extrinsic) motivation to implement what they learned, which aligns with the

finding that they assign instrumental value to homework, learning, and school in general. Another potential explanation for this discrepancy could be related to self-regulation. The grit intervention could have acted as a catalyst, but only for students who were able to use those strategies in a disciplined and self-regulated manner. Conversely, students who stagnated or worsened might have struggled with self-regulation despite remembering the content.

Moreover, the impact of the intervention could also be mediated by external (contextual) factors such as home environment, peer influences, or teacher support. Students who improved may have had more conducive environments for practicing what they learned, while those who stagnated or worsened might have faced contextual barriers that limited the practical application of their knowledge. Findings from the category ‘perceived factors influencing school progress’ seem to support this theory. Students facing stagnation or decline cited not only decreased personal effort but also challenges with new teachers and heightened academic pressures as significant hurdles, suggesting that setbacks often arise from a *combination of individual and systemic factors*. These results also underscore the limitations of the grit interventions when confronted with the strong influence of students’ specific social circumstances, such as problematic family or peer relations and a school culture that often fails to address the needs of a heterogeneous student body. Issues such as varied family backgrounds, migration experiences, language proficiencies, interests, or prior knowledge remain insufficiently addressed by current curricula and didactic approaches.

It is also possible that improved students were at a point in their development where they were more open to change and more receptive to the intervention’s message. The grit principles could have resonated more deeply with their existing goals, helping them make significant behavioral adjustments. In contrast, those who stagnated or worsened may have understood the content but weren’t psychologically or developmentally ready to put it to good use. This line of thinking is supported by findings in the ‘reflections on the uses and effects of the grit courses’ category, which revealed that improved students demonstrated more in-depth engagement with—and application of—the course material. Grade 8 students who improved resonated in particular with forward-looking content, indicating that they might be in a developmental stage where future-oriented thinking is especially relevant, whereas Grade 9 students who improved related more to effort-focused content, reflecting an increasing awareness of the significance of effort as students grow older.

Finally, participants who stagnated or worsened may have experienced cognitive overload or disengagement, meaning that while they remembered the content, they were less likely to focus on or prioritize its relevance to their academic performance. Statements from

the category ‘personal reflections on learning, life, and future goals’ suggest a struggle to associate academic achievement with personal aspirations, a disconnect between the intention to improve and the ability to take action, and a lower propensity to set and achieve goals. Such reflections corroborate the idea that cognitive overload or disengagement may have limited these students’ capacity to prioritize learning and effectively apply the strategies from the intervention. This indicates that both immediate, teacher-supported application of the grit principles following the intervention and sustained, long-term engagement with this content might be crucial for determining the interventions’ outcomes.

It is precisely this sustained engagement that several students—whose comments are explored in the ‘evaluative feedback on grit course design’ category—recognized as important for enhancing the impact of the grit courses. Indeed, integrating grit content into the regular school curriculum could provide numerous advantages over one-time interventions.

Firstly, repeated exposure to these ideas may lead to more sustainable behavioral and attitudinal changes. This aligns with a hypothesis from the quantitative strand of the study, namely that recurrent engagement in gritty behaviors, which reflects shifts in *momentary* personality states, is necessary for long-term changes in generalized self-concept and, consequently, personality traits (Bleidorn et al., 2019).

Secondly, teachers can seamlessly incorporate grit principles into everyday lessons, providing real-time examples of how goal-setting and perseverance contribute to success in specific subjects, thereby creating more organic opportunities for students to apply these concepts. Additionally, teachers’ long-term relationships with their students enable them to offer ongoing guidance and tailor grit-related strategies to individual needs. This sustained interaction allows for personalized feedback, making the grit content more relevant and meaningful to each student’s development. Moreover, teacher involvement creates space for reflective discussions about effort and resilience. In these discussions, teachers can help students identify instances when they are applying grit strategies and support them in remaining focused when academic challenges arise.

Lastly, integrating grit content into the curriculum ensures that all students, not just those in targeted interventions, have access to these valuable tools. Over time, this can foster a school-wide culture where grit is valued and consistently reinforced by both teachers and staff. In this supportive environment, students are encouraged to believe in their ability to grow, set clear goals, stay motivated, and put in the effort needed to succeed.

In conclusion, students’ attitudes toward school and learning, their learning habits, and their reflections on the grit interventions reveal meaningful patterns in the relationship

between academic mindsets, academic behaviors, and school performance. An analysis of these patterns provides a solid foundation for answering RQ 7: “What are the academic mindsets and behaviors underlying the effects of the grit interventions?”

Students who improved academically post-intervention often held an instrumental and future-oriented view of school and learning. They reported learning more frequently and completing their homework more consistently than participants in the other groups and attributed their academic improvement primarily to increased effort and school engagement behaviors such as active class participation. Moreover, these students also demonstrated a deeper engagement with the grit course content. In contrast, those whose performance stagnated or declined tended to focus more on the social aspects of school or expressed dissatisfaction with the school system—which, as already noted, does not cater adequately to students’ diverse social and learning needs—, revealing a disconnect between their intentions to improve and their ability to take actionable steps toward that goal.

Although many students recalled specific elements of the grit interventions—such as goal-setting and learning strategies—the extent to which they applied these concepts varied. This disparity indicates that mere retention of course material does not guarantee academic improvement; instead, factors such as believing in one’s ability to improve (a growth mindset), personal motivation, an instrumental and future-oriented view of school and learning, and frequent engagement in beneficial school-related behaviors appear to mediate the interventions’ effects. Thus, the hypothesis that growth- and future-oriented thinking—central to the grit content—and school engagement are associated with improved school performance was confirmed. This illustrates that fostering such mindsets and behaviors through grit interventions can lead to significant academic advancements. Overall, the findings underscore the potential of grit interventions to cultivate (school) grit, particularly among students with a future-oriented outlook, while emphasizing the need for tailored approaches to address diverse learning needs.

9.8 Evaluation

Qualitative research has inherent limitations when judged against the quality criteria commonly applied to quantitative research, such as reliability, validity, objectivity, and generalizability. Consequently, it is essential to evaluate the data collection and analysis methods used in the present study, as well as the challenges encountered, to ensure a systematic and credible approach.

From an ethical standpoint, every effort was made to address potential concerns. Participation in the focus groups was entirely voluntary, and participants were aware that they

could withdraw at any time without consequences. Students were informed about the true purpose of the focus groups, and the interview schedule was carefully designed to avoid biased, leading, or distressing questions. All focus groups were audio-recorded with participants' consent, and their identities were protected by anonymizing personal information in the transcriptions. Participants were also provided with contact information for inquiries regarding the study or questions about data protection regulations, ensuring transparency and accountability throughout the research process. While excerpts from the conversations are included in this dissertation and may be used in future reports and publications, the complete transcripts will remain confidential. Overall, the collected focus group data was handled according to the prevailing ethical guidelines and standards of good scientific practice in psychological research, including adherence to data protection regulations outlined in the EU General Data Protection Regulation (GDPR) and the ethical principles established by the European Commission for social sciences and humanities research.

To ensure the *trustworthiness* of this qualitative research, I employed several strategies aligned with Lincoln and Guba's (1985, as cited in Thomas, 2006) criteria for trustworthiness: credibility, dependability, confirmability, and transferability. Credibility refers to the confidence in the truth of the findings, akin to validity in quantitative research. Dependability emphasizes the stability and consistency of the findings over time and across various conditions, similar to reliability in quantitative studies. Confirmability ensures that the findings are shaped by the participants rather than the researcher's biases, aligning with the objectivity criterion. Lastly, transferability focuses on the applicability of findings to other contexts or populations, analogous to generalizability. By integrating these criteria into the evaluation of the qualitative strand's methodology, I aim to provide a solid framework for assessing the quality of the present research.

To enhance *credibility*, I recorded the focus groups and transcribed them verbatim, carefully cross-checking the AI-generated transcripts against the original audio to ensure accuracy. While participants were not anonymous to each other due to the nature of the focus groups, I maintained full anonymity in reporting their contributions. This approach helped encourage authentic responses and reduced the potential for social desirability bias, thereby further supporting the study's credibility. As German was the shared language but not the first language for many students or myself, I paraphrased what I believed the participants meant whenever something was unclear and asked them to confirm that my interpretation was correct. Additional efforts were made to ensure the accuracy of the reported data through the use of low-inference descriptors, such as quoting participants directly, using specific language

to describe their statements, and providing numerous extracts of data in this chapter. Although credibility could have been further enhanced through respondent validation (allowing participants to verify the findings) and by incorporating additional data collection methods, such as individual face-to-face interviews, the approach taken offers a robust understanding of the participants' perspectives.

The chosen data collection method—focus groups—and the data analysis method—general inductive approach—were selected based on the research questions and the types of explanations sought. Inductive coding proved to be an effective tool for capturing shared meanings across the data while preserving its richness and complexity, thus supporting both credibility and *dependability*. The coding framework facilitated an in-depth exploration of individual experiences and enabled cross-case comparisons, adding rigor to the analysis.

The absence of a second coder, though not uncommon in studies using inductive coding, precluded inter-rater reliability checks. However, to enhance dependability, I coded the data twice, with a one-week interval in between. The consistency of the results across both coding rounds—including thematic consistency, which indicates that the categories / themes identified in the analysis are coherent and reflect the data collected consistently—suggests that the data analysis process was sufficiently reliable. Although no formal pre-testing of the interview schedule was conducted, I thoroughly documented the development of the schedule, including the formulation of the questions, which adds transparency to the research process. Additionally, I ensured consistency by utilizing the same interview schedule across all focus groups. I was unable to conduct formal member or stakeholder checks because my access to students was limited to the focus groups; however, I provided participants with a summary of their discussions at the end of each focus group session and asked them to confirm its accuracy. This step helped reinforce the stability of the findings and ensured that the interpretations closely reflected participants' perspectives.

The coding process remained closely tied to the participants' language, minimizing researcher inference in the creation of categories, which further supported both credibility and *confirmability*. Efforts were made to analyze the data free from biases stemming from personal values or pre-existing theoretical assumptions. A coding illustration and an abridged coding frame are provided in-text, while the complete coding framework and a full coding example for one question are available in the Appendices. This transparent approach clarifies how conclusions were reached, thereby enhancing the confirmability of the findings.

In qualitative research, *transferability* takes precedence over external validity, as the focus is on providing rich, detailed descriptions that allow others to determine the

applicability of findings to different contexts. While it is likely that the results of this study could be replicated in future research, the subjective nature of the data means that *exact findings* cannot be guaranteed, even when studying the same sample at different times or using a different sample from the same population. Nevertheless, the insights gained about the implementation and impact of the grit interventions can be transferred to other educational settings where similar conditions exist. In other words, the findings offer valuable theoretical propositions that may be relevant to other student populations in Germany and beyond. Identifying shared patterns and meaningful differences in the data enables readers to assess whether these results could inform interventions in other educational contexts. However, in the spirit of naturalistic inquiry, as suggested by Guba (1978, p. 70, as cited in Patton, 2002, p. 583), “the evaluator ... should regard each possible generalization only as a working hypothesis to be tested again in the next encounter and again in the encounter after that”.

The connection between the qualitative findings and those from the quantitative strand of this mixed-methods study, which serves as a form of data triangulation, further supports the potential for broader applicability or transferability of the findings. The quantitative analysis revealed that higher socio-educational advantage (SEA), school grit, and school self-efficacy are significantly associated with increased GPA, with school grit acting as a strong predictor that accounts for unique variance in grades beyond other constructs. The results also demonstrated that the grit interventions resulted in improved GPA and self-selected goal achievement compared to the control group. Additionally, school engagement served as a mediator in both the relationship between grit and GPA and the effects of the interventions on GPA. These findings are echoed in the qualitative data, which show that students who improved academically post-intervention had a growth / future-oriented perspective on their education (typical of school grit), actively engaged in their learning, and consistently completed their assignments (typical of high school engagement). This connection will be explored in greater depth in the following chapter, which integrates the quantitative and qualitative strands, provides a general discussion of the research outcomes, and suggests areas for future research.

10 Reflections on Grit: Findings, Evaluation, and Implications for Education

This chapter integrates findings from the implementation phase—comprising quantitative cross-sectional and longitudinal studies—and the evaluation phase, which involved a post-intervention qualitative study. To provide a robust and meaningful synthesis of these results, the discussion is organized **thematically** rather than by consecutively summarizing and contextualizing the findings for each research question (RQ). These overarching themes address key concerns or areas of inquiry that span multiple RQs across both strands of the study. Some themes connect the cross-sectional and longitudinal analyses within the quantitative strand and lack accompanying qualitative results, while the majority integrate findings across both strands. For themes that bridge the quantitative and qualitative findings, Integrated Results Matrices are presented. These matrices juxtapose quantitative and qualitative outcomes—classified as convergent, complementary, or divergent—and incorporate illustrative quotes from the focus group data, enabling a side-by-side comparison that reflects the elaborative intent of the mixed-methods sequential explanatory design (McCrudden et al., 2021).

This thematic approach aligns with Ivankova et al. (2006), who emphasized the importance of grouping findings from quantitative and qualitative RQs within each thematic area to develop a more comprehensive understanding of the research problem, thereby enhancing the quality of inferences. By situating these integrated findings within existing theory and previous research, this chapter highlights their broader significance and identifies how they address debated questions in the field. Following this thematic discussion, future directions for grit research are considered, with a focus on grit's role in school-based interventions within the German education system. The chapter concludes with an evaluation of the project as a whole, highlighting its weaknesses and contributions across all phases.

10.1 Interpreting Themes Spanning Quantitative and Qualitative Findings

10.1.1 *The Importance of Domain-Specific Grit (RQ1, 2a, 3d)*

The first key quantitative finding revealed that school-specific grit, compared to general grit, exhibits stronger associations with conscientiousness, school self-efficacy, school self-control, and particularly school engagement, underscoring its distinct relevance in the school context. Furthermore, school grit, unlike general grit, explains additional variance in students' GPA beyond demographic factors and, importantly, beyond related constructs such as conscientiousness. Similarly, baseline school grit, rather than general grit, emerged as the strongest predictor of goal-directed effort and progress toward self-selected goals, surpassing

the effects of the interventions. These findings reinforce the importance of conceptualizing and measuring grit as a domain-specific construct, aligning with evidence from the limited studies on grit's domain-specificity (e.g., Cormier et al., 2019). This perspective is further substantiated by the inverse correlation between school and general grit residuals, which supports Duckworth and Quinn's (2009) assumption that individuals can display grit in one domain without necessarily exhibiting it in other areas of life.

10.1.2 Grit's Unique Explanatory Power for Academic Performance (RQ 2a, 2b)

The second important quantitative finding was that overall school grit—not its perseverance facet, as hypothesized based on much of the grit literature (e.g., Credé et al., 2017)—was the fourth strongest predictor of pre-intervention GPA in terms of relative importance (i.e., percentage of explained variance). It followed school engagement, socio-educational advantage (SEA), and school self-efficacy, with its relative importance comparable to that of the other three contributors, reflecting its significance for academic performance. At the next measurement point¹⁷¹, school grit emerged as the second strongest predictor of GPA in terms of both the size of its standardized regression coefficient and its relative importance, following school engagement. Interestingly, in bivariate correlations, school grit and school engagement exhibited identical strengths of association with GPA.

These findings align with studies indicating that school engagement is a stronger predictor of grades than grit (e.g., Steinmayr et al., 2018). This is logical, given that school engagement represents the behavioral mechanism through which non-cognitive skills, such as grit, influence grades, making it the most proximal predictor of academic performance (Farrington et al., 2012)¹⁷². However, these results diverge from studies suggesting that other predictors, such as conscientiousness, outweigh grit in predicting academic performance (e.g., Credé et al., 2017; Ivcevic & Brackett, 2014; Minnigh et al., 2024; Rimfeld et al., 2016; Zisman & Ganzach, 2021).

The shift in school grit's predictive power occurred despite grit scores themselves remaining stable over time. The non-significant increase in grades from T1 to T3 further suggests that the change reflects grit's evolving relative importance to GPA, possibly due to a decline in the predictive strength of other variables, such as SEA and self-efficacy, which may

¹⁷¹ Although I did not carry out a fully-fledged cross-sectional study at Time 2/3 (as self-report measures collected at T2 align with GPA at T3), I am fortunate to have the opportunity to explore the relationships between grit, its correlates, and GPA at a second time point (see also Appendix F.6, p. 353). This allows me to assess the stability of these relationships and explore any notable shifts. I will refer to Time 2 findings only when they differ from those at Time 1, considering potential explanations, including possible intervention effects, for any observed changes.

¹⁷² cf. Dixon (2021) for a study in which educational engagement explained less variance in GPA than academic self-concept.

have amplified the role of individual differences in grit. Analyses of pre-intervention data restricted to participants who remained in the study at the second measurement point confirmed that these changes were not attributable to attrition.

Overall, these findings indicate that while self-reported school grit is relatively stable, its relevance to academic outcomes can fluctuate in response to contextual and developmental factors, highlighting the importance of fostering grit-related behaviors in educational settings.

10.1.3 Grit's Importance for Disadvantaged Students (RQ 2c, 5)

The analysis of school grit's conditional effects at varying levels of socio-educational advantage (SEA) indicates that its positive association with GPA is stronger for students with low or moderate SEA, whereas this relationship weakens and loses significance for students with high SEA. These results support the research project's central hypothesis that school grit is particularly critical for disadvantaged students—who generally score lower on measures of grit and related constructs—and that it has a greater impact on their academic outcomes.

The cross-sectional findings are strongly supported by longitudinal results. Students in Cluster 1—characterized by lower levels of grit, school engagement, and SEA, as well as lower baseline academic performance and an almost 2:1 male-to-female ratio—demonstrated significant GPA improvements across all intervention groups, but not in the control group. In contrast, Cluster 2 students, who began with significantly higher GPA scores, exhibited smaller improvements or even stagnated post-intervention, likely due to ceiling effects, underscoring the interventions' targeted effectiveness for the more disadvantaged students in Cluster 1. Notably, Cluster 2 students in the control group experienced a significant GPA decline from T2 to T5, but those in experimental groups maintained their performance, suggesting that the interventions also played a protective role for more advantaged students.

These findings align with evidence suggesting that grit is particularly valuable for students who face disadvantages (Cosgrove et al., 2018; Fosnacht & Webb-Copridge, 2021; Hatchimonji et al., 2022; Hodge et al., 2018; Huang & Zhu, 2017; O'Neal et al., 2018; Strayhorn, 2014; Tovar-García, 2017). Additionally, they back research indicating that *interventions* targeting non-cognitive skills such as grit, growth mindset, or social belonging are especially effective for underprivileged students (Santos et al., 2021; Yeager, Walton, et al., 2016). This is likely because such students experience higher psychological barriers¹⁷³, such as stereotype threat, which the interventions help address (e.g., Yeager & Dweck, 2012).

Finally, given the composition of Cluster 1, these findings support the proposition that

¹⁷³ This group of students also faces significant structural barriers to equitable education, which remain beyond the scope of social-psychological interventions in education. This point will be addressed later in the chapter.

“boys from low SES families may stand to benefit most from interventions addressing grit, goal setting, goal commitment, and achievement” (Tang et al., 2019, p. 481). This is particularly relevant within the German education system, where “boys from social classes characterized by socio-economic and educational disadvantages (with or without migrant background)” are disproportionately “at risk of leaving school without a diploma or clear perspectives for the future” (Theunert, 2020, p. 7).

10.1.4 Grit’s Importance for Lower-Ability / Lower-Performing Students (RQ 2c, 5)

The cross-sectional analysis (Chapter 7) revealed that the relationship between school grit and GPA was strongest among students with the lowest academic ability, followed by those with the highest academic ability. This finding aligns with Light and Nencka’s (2019) study, which showed that grit has its greatest impact at the extremes of the cognitive ability spectrum. High-ability students use grit to enhance self-regulated learning in response to demanding tasks, while low-ability students rely on grit to compensate for cognitive limitations. However, Gil-Hernández (2021) found that non-cognitive skills like conscientiousness could compensate for low cognitive ability only among students with high SES, highlighting the potential moderating role of socio-economic (dis)advantage.

The longitudinal analysis (Chapter 8) further emphasizes the importance of grit for low-ability students. Cluster 1, consisting of students with both low academic ability and low SEA, began with significantly lower GPA scores but demonstrated meaningful improvements following the intervention. This suggests that grit may be especially important for overcoming educational challenges. In contrast, Cluster 2, consisting of higher-ability students, showed no significant improvements across any condition, likely due to ceiling effects. These findings are consistent with prior research indicating that mindset interventions such as those focused on growth mindset or sense-of-purpose are most effective for underperforming students, due to both intervention and ceiling effects (Paunesku et al., 2015; Yeager et al., 2019).

10.1.5 The Growth Mindset Conundrum: Exploring Inconsistent Results (RQ 1, 2a, 3d-e, 7)

Unexpectedly, mindset, where higher scores indicate a more fixed mindset, showed no significant correlation with grit or its subscales pre-intervention, and small positive coefficients suggested a weak association between grit and a fixed mindset. This finding contrasts with most of the existing literature (e.g., Kannangara et al., 2018; D. Park et al., 2020; West et al., 2016; T. Zhang et al., 2022). At Time 2, however, mindset was *negatively* correlated with overall grit and its facets¹⁷⁴, aligning with the hypothesis that growth mindset

¹⁷⁴ See Appendix F.6, p. 353 for T2 correlations between mindset and grit.

and grit go hand in hand. Among those correlations, the relationship with domain-general consistency of interests, though still small, reached significance at the .05 level.

Although neither mindset nor grit scores changed significantly over time (RQ 3a-b), the improved conceptual coherence of responses at Time 2 may reflect increased familiarity with the concept of intelligence emphasized in the grit interventions and/or a growing recognition that intelligence is not fixed. While these shifts were not fully reflected in self-reported mindset scores, the low test-retest correlation for mindset ($r = .455, p < .01$)—the lowest among all measured variables—suggests it is relatively less stable over time. This instability may reflect an enhanced understanding of intelligence, intervention effects fostering the internalization of growth-mindset principles, or natural cognitive maturation.

An analysis of Time 1 (T1) correlations using only students who completed both pre- and post-intervention questionnaires confirmed that the observed changes in the relationship between mindset and grit from T1 to T2 are not attributable to attrition. The consistency of T1 correlations across the full ($n = 205$) and reduced ($n = 190$) samples suggests that the shift at T2 reflects genuine conceptual changes rather than sample composition effects. This strengthens the interpretation that the intervention, alongside cognitive maturation, may have improved students' understanding of intelligence and its connection to effort and perseverance, leading to a better theoretical alignment between these constructs at T2.

As far as its relationship to school performance is concerned, mindset exhibited a weak, non-significant negative bivariate correlation with GPA at T1, a pattern replicated at T2/ T3¹⁷⁵. However, in the hierarchical regression analysis, after controlling for demographic variables and school grit, mindset emerged as a significant negative predictor of GPA at T1, which aligns with the research-backed hypothesis that a growth mindset (reflected by lower scores on the mindset variable) is associated with better academic performance (e.g., Blackwell et al., 2007; Claro et al., 2016; Rege et al., 2021)¹⁷⁶.

Despite the lack of change in the self-reported mindset variable pre- and post-intervention, as well as weak or inconsistent associations between mindset, grit, and GPA, students in the experimental conditions featuring the growth mindset module (AM and COMB) showed significant GPA improvements: from T1 to T2 in the COMB group and from T2 to T5 in the AM group. Moreover, students in these two conditions were more likely to report that their self-selected school goal remained important to them eight months post-

¹⁷⁵ See Appendix F.6, p. 353 for T2 correlations between mindset and GPA.

¹⁷⁶ However, two meta-analyses by Sisk et al. (2018) revealed that the overall relationship between mindsets and academic achievement, as well as the effects of mindset interventions on achievement, were weak. Despite this, specific subgroups like academically high-risk and low-SES students were shown to benefit significantly.

intervention compared to students in the control group.

The qualitative findings diverge from quantitative results suggesting that mindset plays only a minor role in relation to grit or academic performance. However, they converge with and complement the positive, statistically significant effects associated with exposure to the growth mindset intervention content. The focus group discussions reveal that (primarily) those students who improved after the intervention engaged frequently with the growth mindset content and resonated deeply with this material. They often cited motivational elements from this module, such as the information about the brain's plasticity, the video conveying the message that 'you can learn anything', John Legend's 'success through effort' video, and the 'success iceberg' metaphor. Within the subcategory 'effective or engaging content', the growth mindset module was referenced far more frequently than any other type of content (15 mentions), indicating its likely influence on students' attitudes toward learning and self-improvement, and on their motivation to improve in school. Table 10.1 (below) provides a matrix that integrates the quantitative and qualitative results and illustrates the qualitative findings with representative quotes.

Table 10.1

Integrated Results Matrix: Growth Mindset, Grit, GPA, and Student Motivation

Quantitative results	Qualitative results (Conv., Compl., Div.)	Example quotes
Weak, non-significant positive correlations between mindset and grit (+ facets) at T1.	Students were able to recall videos from the GM module 13 months after the intervention.	"When [I learned] about our brain and how success is achieved, I became more aware of what I was doing, why I was doing it, and what I wanted".
Weak, partially significant negative correlations between mindset and grit (+ its facets) at T2.	The GM module was the most frequently referenced content across both grit courses.	"When I watched the video and understood that you need a lot of patience to study and that you also invest a lot of time in it, I realized that I want to get my Abitur, and that I have to build up my patience to actually do that".
Weak, non-significant negative correlations between mindset and GPA at T1 and T2/T3.		"The video with John Legend gave me motivation to get a better school-leaving certificate".
A growth mindset was associated with higher GPA at T1 ($b = -.128$, $\beta = -.162$, $p = .011$).	Students reported feeling motivated by learning that intelligence is malleable and that success requires effort and persistence.	"I found it interesting to see how [someone] was at the very bottom and then managed to improve. And anyone could actually do that if they learn a lot and decide what they want to be or do. So this motivates you to do more".
Students in the AM and COMB groups showed significant GPA improvements.		"At first, I thought I wouldn't be able to graduate. Then I saw the video and thought, yes, I'm sure I'll manage if I study more and get good grades".

Note. Conv. = convergent; Compl. = complementary; Div. = divergent; GM = growth mindset; AM = academic mindsets; COMB = combined condition; T1 / T2 / T3 = Time 1 / 2 / 3

10.1.6 Engagement as a Mediator of the Grit-Performance Relationship (RQ 2d, 6, 7)

Pre-intervention results indicate that school engagement mediated the relationship between school grit and GPA, as hypothesized based on theoretical frameworks such as those proposed by Farrington et al. (2012) and Snipes et al. (2012) (Chapter 3). These findings also align with research that identifies engagement as a mediator between grit and achievement or performance (e.g., Hagger & Hamilton, 2019; Hodge et al., 2018; Khajavy, 2021; O’Neal et al., 2018; Yoon et al., 2020). At T1, engagement fully mediated the relationship between school grit and GPA. However, at the subsequent measurement point (T2/T3), engagement only partially mediated this relationship, suggesting that school grit also influenced GPA independently, potentially through additional mechanisms not captured by the mediator, such as more efficient learning strategies or help-seeking behaviors.

Longitudinal findings further highlight the role of school engagement as a mediator. Both the AM and LSS interventions indirectly influenced GPA change through engagement, with full mediation observed in the LSS group. In the AM group, while the indirect effect through engagement was significant, the total effects on GPA change were not, indicating that the intervention’s overall impact was insufficient to differentiate this group from the control.

Taken together, these findings reinforce school engagement’s role as a primary (though not exclusive) behavioral mechanism linking grit (as a personal attribute) and the grit interventions to academic performance. Thus, the results largely confirm the portion of the theoretical model proposed in Chapter 3 that posited a pathway from grit to academic performance through school engagement.

The qualitative findings converge with the quantitative results discussed above. Focus group participants who improved academically post-intervention attributed their success to increased effort and school engagement, while those who stagnated or declined cited reduced effort as an important reason for their outcomes. Notably, in the subcategory ‘high learning frequency’, seven of the nine responses came from improved students, highlighting consistent learning at home as a key academic behavior that translates into better school performance. Similarly, in the subcategory ‘homework value’, only students from the improved groups reflected on the significance of completing homework, whereas those who stagnated or declined were overrepresented in the subcategory ‘inconsistent homework completion’. These findings reinforce the role of school engagement—operationalized in the focus group discussions as learning at home and homework completion—as a mediator between grit (or the grit interventions) and GPA improvements. Table 10.2 (p. 254) summarizes these results and includes illustrative quotes to highlight the qualitative findings.

Table 10.2*Integrated Results Matrix: School Engagement's Role as a Mediator*

Quantitative results	Qualitative results (Convergent)	Example quotes
School engagement fully mediated the relationship between school grit and GPA at T1.	Students who improved post-intervention attributed their success to increased effort,	Quotes from students who improved: “In Grade 7, I was absent a lot. I mostly didn't do my homework or I forgot it very often, and that's why I've started to study more now”. “Most of it happened because I started to speak up more in class, ... to participate more”.
School engagement partially mediated the relationship between school grit and GPA at T2/T3.	while those who stagnated or declined often cited reduced effort as a contributing factor.	“I really tried hard because I saw that Grade 9 is important. Now ... I am trying to get another advanced course so that I can do my Abitur”.
School engagement at T2 mediated the effect of the AM and LSS interventions on the change in GPA, with full mediation in the LSS group (though the AM intervention lacked significant total effects on GPA compared to Control).	Students in the improved groups were more likely to exhibit consistent learning behaviors.	Quotes from students who stagnated / declined: “I learned less”. “I also learned relatively little and was distracted”. “I didn't even realize that things were getting more serious, which is why I didn't put much effort into school”. “I think that none of us try that hard in the first term because we think, okay, we'll do better in the next term”.

Note. AM = academic mindsets; LSS = learning skills and strategies; T1 / T2 / T3 = Time 1 / 2 / 3

10.1.7 The Importance of the Performance Domain (RQ 2a, 2b, 3d, 3e, 7)

Researchers have suggested that grit might be more relevant to personally meaningful, self-selected goals than to broad, externally imposed outcomes like school grades (e.g., Duckworth & Quinn, 2009; Ivcevic & Brackett, 2014). Although this hypothesis was not explicitly tested in the present research, the inclusion of both objective and subjective outcomes provides valuable insights into how grit and the grit interventions influenced these different domains. Findings reveal that both self-reported school grit and the grit interventions had positive effects on objective measures like GPA and subjective outcomes like progress toward school and personal goals.

Trait-level school grit was strongly associated with GPA at both Time 1 and Time 2/3. Moreover, across all groups, baseline school grit emerged as the strongest predictor of school goal-directed effort and progress, surpassing the effects of the interventions and highlighting its central role in goal achievement. The grit interventions themselves also demonstrated notable effects: they were linked to significant GPA improvements (from T1 to T2 in the COMB and LSS conditions, and from T2 to T5 in the AM condition) compared to the control group, as well as higher scores on self-selected school and personal goal progress (significant in the LSS group) and school goal importance (marginal in the AM group).

These findings indicate that both objective and subjective outcomes benefited from grit and the grit interventions, underscoring the interventions' broad applicability. However, without explicit moderation analyses or comparisons of effect strength, it remains unclear whether the performance domain moderates the impact of grit or grit interventions. Future research could explore this question further to determine whether grit is particularly beneficial in certain contexts or for specific types of outcomes (see also Credé et al., 2017).

The findings from the qualitative strand reinforce the inference that the grit interventions benefited both broad, objective academic outcomes, such as school grades, and self-selected, personally meaningful school and personal goals. Students reported that ideas and thoughts inspired by the interventions helped them improve in specific subjects, while motivational video content bolstered their belief in their ability to study more effectively and achieve good grades. Additionally, students described the WOOP goal-setting strategy as "helpful" and reported using it to set and accomplish both academic and personal goals. Table 10.3 (below) synthesizes these conclusions, pairing key themes with illustrative quotes.

10.1.8 The Impact Paradox: Intervention Effectiveness on Grades vs. Self-Report Measures (RQ 3a, 3b, 3c, 3e, 7)

The interventions' significant positive effects on GPA, observed both shortly after implementation (T2) and over a 2.5-year period (T5), despite the absence of significant changes in self-reported grit and school engagement, suggest that their mechanisms of influence extend beyond what is captured by self-report measures. Similar findings have been reported in grit intervention research. For instance, Hoskie (2023) found that a grit and growth

Table 10.3

Integrated Results Matrix: Importance of Performance Domain

Quantitative results	Qualitative results (Convergent)	Example quotes
Findings indicate that self-reported school grit and the grit interventions are relevant / impactful for both objective outcomes (e.g., GPA) and subjective outcomes (e.g., self-selected school goals).	The grit courses supported both school outcomes, such as better grades, and personal goal achievement, with students highlighting the motivational AM content and the WOOP strategy as helpful tools.	"I would recommend it to people who don't know what their goals are or how to achieve them". "I saw the video and thought, yes, I'm sure I'll manage if I study more and ... get good grades". "These thoughts [about the future] helped me a lot to learn better in some subjects". "I set goals for any subject so that I get good grades" "I thought the WOOP method was good, I filled out [the card] and then achieved my goal this way". "I had set myself the goal of playing more basketball. And ... after [the course], I was fully motivated ... And I did reach my goal! [The WOOP method] definitely made a difference".

Note. AM = academic mindsets; WOOP = goal-setting strategy (Wish, Outcome, Obstacle, Plan)

mindset intervention enhanced academic performance in English Language Arts and Math assessments without improving grit scores. Moreover, focus group responses revealed an increased use of language related to grit, growth mindset, and self-efficacy, pointing to shifts in attitudes or behaviors that were not reflected in self-reported measures. Separately, a large-scale deliberate practice-focused grit intervention for middle schoolers actually *reduced* self-reported grit—specifically the consistency of interests facet—while significantly improving academic performance, especially among disadvantaged students. GPA impacts became more pronounced over time, with modest gains observed among males and students with lower pre-treatment GPAs, and more substantial, sustained improvements among Roma students¹⁷⁷ (Santos et al., 2021). Similarly, a large-scale growth mindset-focused grit intervention with fourth-grade students produced “remarkably large and significant” (p. 1150) short-term improvements in math performance and persistent long-term gains across two independent samples (Alan et al., 2019). However, the study provided only “suggestive” evidence that these improvements were linked to changes in self-reported grit, as post-intervention differences between treatment and control groups were analyzed using Ordinary Least Squares regressions, without tracking within-student changes in grit over time.

Jones et al. (2018) is the only study I am aware of to report concurrent positive effects on both self-reported grit and academic outcomes. Using a five-item goal persistence measure, the study found that the intervention led to short-term increases in grit and modest grade improvements mediated by this increase. However, neither effect persisted at a follow-up six months later. While this study highlights the immediate potential of grit interventions, it does not provide conclusive evidence that self-reported grit can be enhanced long-term.

The grit interventions in the current project may have had immediate effects on subtle or context-specific behaviors that influenced performance, while shifts in self-concept (e.g., perceiving oneself as grittier) might require more time to develop and stabilize. Alternatively, since grit was measured eight months post-intervention, it is possible that changes in grit occurred shortly after the intervention but dissipated over time as the salience of the intervention content diminished, aligning with the findings of Jones et al. (2018). Moreover, ceiling effects may have limited measurable improvements for students who already rated themselves highly on grit and engagement at baseline. These factors could help explain the lack of significant changes in self-reported measures.

Based on the current data, the first part of the model proposed in Chapter 3, which

¹⁷⁷ Students from the disadvantaged Roma minority in North Macedonia.

posited that the interventions would influence behaviors and outcomes through their impact on grit, cannot be confirmed. Thus, it could be tempting to dismiss the observed effects on GPA as a fluke or statistical artifact given the absence of corresponding changes in self-report data. However, the lack of GPA improvement in the control group at any measurement point over 2.5 school years suggests that the gains in the experimental groups were driven by intervention-specific content rather than general developmental trends or external influences.

The findings point to several potential mechanisms through which the intervention may have influenced outcomes. The grit courses may have indirectly enhanced academic performance through contextual factors, such as improved relationships with teachers and peers, supported by the school belonging module. Additionally, peer effects could have played a role, as treated students may have adjusted their beliefs and behaviors in response to observing other treated peers demonstrating greater grit. This phenomenon, supported by laboratory studies on perseverance (Buechel et al., 2018; Gerhards & Gravert, 2020), could foster a classroom culture where gritty behavior becomes the norm.

Students may have also internalized and applied goal-setting, self-control, or deliberate practice strategies that fostered behaviors not captured by the school engagement scale. These actions might include planning to overcome obstacles, seeking feedback from teachers, peers, or parents (a key step of deliberate practice), or modifying the study environment to avoid distractions and enhance focus (a self-control strategy known as situation modification). Additionally, recursive processes targeted by the growth mindset module (see section 3.4 for a discussion of psychologically wise interventions)—where attributing success to high effort fosters a self-reinforcing cycle of increased effort and success—could explain the intervention’s apparent long-term impact, particularly in the AM group. Another internal factor beyond the scope of the self-report measures is the development of a stronger *sense of purpose*. These mechanisms likely interact in complex ways, warranting further investigation to identify the specific mindset shifts and behaviors driving the observed effects. The qualitative findings offer preliminary insights into these dynamics, demonstrating that students utilized both motivational and practical resources to achieve academic improvements (see also Table 10.1, p. 252, and Table 10.3, p. 255).

In addition to drawing motivation from content in the growth mindset module (section 10.1.5), focus group participants highlighted how both the AM and LSS interventions encouraged future-oriented thinking. The WOOP goal-setting strategy (LSS course) prompted students to identify a goal, envision its best outcome, and create a plan to overcome potential obstacles (section 10.1.7). Meanwhile, the sense of purpose module (AM course) emphasized

future-oriented thinking by incorporating both personal and self-transcendent reasons for working hard in school and by encouraging students to reflect on their motivations and goals for learning. This module included quotes from anonymous peers about their aspirations and a written reflection exercise asking, “How can school help you achieve your goals?”

This emphasis on future-oriented thinking may have been an important mechanism through which the interventions improved academic outcomes by shifting students’ focus from immediate challenges to the long-term benefits of schoolwork. Such shifts in perspective (illustrated with student quotes in Table 10.4, below) are not captured by self-report measures, including (school) grit, self-control, self-efficacy, behavioral engagement, or mindset.

10.1.9 What Do Heterogeneous Results Tell Us About the Grit Interventions’ Effectiveness? (RQ 3a-g, 7)

When considering students who participated in one of the grit interventions but did not experience significant academic improvement or achieve their self-selected personal or academic goals to the same extent as their peers, two perspectives emerge. On the one hand, it is essential to examine why the interventions may not have been as effective for these students—beyond potential ceiling effects—or why the content may not have resonated as intended. This line of reasoning reflects a broader shift in psychological intervention research toward embracing treatment-effect heterogeneity. Historically viewed as a limitation indicating small or unreliable effects, heterogeneity is now increasingly recognized as a

Table 10.4

Integrated Results Matrix: Intervention Impact and the Role of Future-Oriented Thinking

Quantitative results	Qualitative results (Complementary)	Example quotes
The grit interventions had a positive effect on students’ GPA in the experimental groups. The LSS group also performed better on measures of self-selected goal progress. However, there were no intervention effects on self-reported grit, school engagement, and other related constructs.	The sense of purpose module (AM course) and the WOOP module (LSS course) emphasized future-oriented thinking, encouraging students to reflect on both personally meaningful and self-transcendent goals.	“I find it good that we were asked questions about the future; I think it’s beneficial because it encourages you to reflect. ... Before the course, I hadn’t considered my plans for the future”. “I believe [what changed] was thinking about the future, because these thoughts came then all of a sudden. So personally, this helped me a lot to learn better in some subjects”. “I didn’t learn that much before, but then I started thinking about learning more, because it would be more beneficial for me in life ... , rather than learning nothing at all; because then I wouldn’t have a degree and wouldn’t ... find a job”. “I would recommend [the course] to someone because it raises very important questions about your future or why you are not learning”.

Note. AM = academic mindsets; LSS = learning skills & strategies; WOOP = goal-setting strategy

reflection of real-world complexity, where psychological phenomena vary across people and contexts. Examining where, for whom, and under which conditions interventions succeed or fail provides valuable insights for refining theories, improving interventions, and understanding the mechanisms driving their effects (Yeager et al., 2022).

On the other hand, evaluating the broader impact of the interventions requires recognizing that—and investigating how—the grit courses may have still provided value to students who stagnated or declined academically post-intervention, even if those benefits were not immediately apparent or measurable through quantitative methods.

Student Narratives: Gains and Challenges. Starting with the ‘unseen’ intervention benefits, the focus group analysis revealed that many students in the stagnated / declined groups evaluated the grit interventions positively, reporting that they had learned something personally meaningful, altered their approach to certain challenges, or felt motivated by the content. These students may not have been able to translate the useful lessons into measurable improvements within the first year for reasons discussed in the second half of this section. Alternatively, it is possible that these students experienced delayed progress and are among those showing gains 1.5 to 2.5 years post-intervention; however, without the ability to link individual long-term outcomes to focus group participants, this possibility cannot be definitively confirmed. Table 10.5 (p. 260) presents these divergent qualitative findings alongside exemplary quotes.

While these insights are particularly encouraging, the focus group discussions also shed light on reasons behind students’ academic or social struggles, as well as several factors that may have limited the effectiveness of the grit courses for some participants. For instance, the value of the intervention content was perceived to depend on the student’s level of *commitment*. One participant emphasized that its effectiveness hinges on the content being taken seriously and being engaged with fully, describing the Academic Mindsets course as “unnecessary” due to a lack of concentration and participation among peers. Statements from students whose academic performance stagnated or declined post-intervention further suggest a struggle to connect academic achievement with personal aspirations, a gap between intentions and actions, and a *lower inclination to set and achieve goals*. These reflections indicate that factors such as cognitive overload, disengagement, or lack of commitment—either toward own goals or toward the grit courses—may have impeded the application of intervention strategies. Furthermore, these findings align with research by Tang et al. (2019), which highlights the critical role of goal commitment in academic success. Their study demonstrates that adolescents who combine high grit-perseverance with strong commitment

Table 10.5*Integrated Results Matrix: Intervention Effects on Students Who Did Not Improve*

Quantitative results	Qualitative results (Divergent)	Example quotes
Non-significant decline in GPA in the AM group from T1 to T2. Non-significant decline in GPA in the LSS group from T2 to T4. Stagnating GPA in the COMB group from T2 to T5. Intervention effects driven primarily by disadvantaged and poorly performing students. More advantaged and higher ability students did <i>not</i> improve significantly.	Even students who did not improve academically in the school year after the intervention reported feeling motivated by learning that intelligence is malleable and that success requires effort and persistence.	“I thought it was really nice that it was shown that you can't be successful just like that. And I saw for myself afterwards that I have to work hard or generally do things to make it happen ...”. “I thought it was good that we learned that the brain is just a muscle and that it changes. And I felt a bit more motivated afterwards”. “After the course, I noticed: OK, you put too much pressure or strain on your brain. It does learn what you want it to learn, but over time. So I personally learned [that] I have to give my brain a bit of time so that it can understand [things], and I no longer pushed so hard, ‘<i>I can't do this. I can't do it</i>’, but I gave myself time instead”. “I found this WOOP [strategy] very interesting: you learn step by step how to achieve your goal”. “I was more motivated and did a bit more because I knew that success doesn't just come like that”.

Note. AM = academic mindsets; LSS = learning skills & strategies; COMB = combined intervention condition; WOOP = goal-setting strategy; T1 / T2 / T4 / T5 = Time 1 / 2 / 4 / 5

to academic goals and moderate grit-consistency achieve the highest academic performance. However, this optimal combination is uncommon and is more frequently observed among girls, students from higher socioeconomic backgrounds, and those with high educational aspirations, underscoring the importance of sustained (teacher) support and tailored approaches to enhance the effectiveness of grit interventions for all students.

At the same time, students also acknowledged factors *beyond* personal school-related efforts that shaped their academic trajectories. Those in the improved groups credited their progress not only to their own hard work but also to changes in teaching staff, which created a more supportive environment. Conversely, some students who experienced academic decline pointed to teacher changes as having had a negative impact on their performance. Moreover, students who did not improve reported struggling with heightened pressure and academic demands that were misaligned with their individual levels or needs. These findings suggest that while personal effort is pivotal for academic growth, setbacks or lack of progress are often shaped by a mix of inconsistent effort, an unsupportive environment, and escalating academic pressures. Table 10.6 (p. 261) synthesizes qualitative findings that complement and contextualize the modest or negligible gains observed in some quantitative analyses.

Students' reflections provide valuable insights into personal and contextual factors influencing the variability in treatment effects. Building on these perspectives, it is crucial to

Table 10.6*Integrated Results Matrix: Factors Limiting the Effectiveness of the Intervention*

Quantitative results	Qualitative results (Complementary)	Example quotes
Same as in Table 10.5 (p. 260)	Lack of interest or commitment may have diminished the interventions' effectiveness. Some students struggled to connect doing well in school with achieving (future) goals*. Those who declined cited unhelpful teachers, rising pressure, and misaligned demands as main challenges.	"I actually found [the course] a bit unnecessary because most of the time the children weren't concentrating on it". "I felt a bit more motivated afterwards ... but that went away after a few days". "I don't have a plan for how my life should go ... because something always comes up that could get in the way". "I just go through life ... to see what happens". "Getting better at school isn't really a goal of mine". "With the other teacher, [I had] better grades and he could teach better than the current one". "[I did worse] because I don't like some teachers, or they grade too strictly, like my new teacher". "There was a big increase in demands, assignments, and everything..." "[My grades declined] because the topics have often become much harder".

Note. *Only students in the AM and COMB conditions participated in the sense of purpose module, designed to help them link their schoolwork to broader personal aspirations.

examine broader (structural) factors, such as aspects of the research design, language barriers, and (un)supportive environments, which interact in complex ways to shape the interventions' outcomes across diverse student groups.

Practical Challenges. Several pragmatic factors related to the research design may help explain why the interventions were less effective for certain students. First, differences in teacher support for the study before the interventions and variations in rule enforcement during their implementation, likely contributed to inconsistencies in student participation and engagement across classes. As discussed in Chapter 5, this represents a significant methodological limitation. Without a school-wide strategy that allocates sufficient time and resources and secures the full support of school leadership and teaching staff, researchers are reliant on the goodwill of individual teachers to ensure smooth and uniform implementation.

A second potential limitation of the intervention's effectiveness lies in its one-time nature. Ironically, although the relevant content was delivered only once, the interventions required multiple implementation and data-collection sessions over a 13-month period, encompassing the actual grit sessions, survey administration at two time points, the math game at two time points, and four focus group discussions. This format required participating students—and occasionally teachers—to miss several class periods throughout the school year, rendering a more extensive intervention unfeasible. While a single 'nudge' may be

sufficient for some students—especially in the AM modules, which align with principles of psychologically wise interventions—others may require repeated exposure to fully grasp and benefit from the material. The LSS intervention, with its focus on practical, hands-on strategies, would have particularly benefitted from booster sessions for all students. Unfortunately, such sessions were beyond the scope of this research project.

Third, despite rigorous efforts before and after the pilot test to ensure that all intervention materials were appropriate in terms of language difficulty (see Chapter 4), comprehension checks and evaluation forms completed after the interventions revealed that some students struggled to understand certain terms. Although this issue was not widespread, students who could not fully benefit from the content due to limited German proficiency or poor reading comprehension are among those the interventions aimed to support the most.

Seed and Soil. When reflecting on the interplay between personal and contextual resources, it becomes evident that some students may have required additional guidance or support from teachers, peers, or parents to sustain their efforts—particularly if they had not yet developed the self-regulation or motivation needed to apply what they learned effectively. The critical role of supportive—or lack of supportive—environments, already addressed briefly in Chapter 3 (section 3.2.2), merits further investigation. As Walton and Yeager (2020, p. 224) astutely state, “psychological interventions are done with people, not on people, and these people live in dynamic and diverse social contexts”.

Just as peer effects can foster perseverance (see section 10.1.8), treated and untreated peers who view intellectual challenges as undesirable or uncool—a common phenomenon in (early) adolescence that disproportionately impacts disadvantaged students (Polirstok, 2017)—can create an unsupportive *peer climate* that diminishes intervention effects. Yeager et al. (2019) demonstrated that a brief, online growth mindset intervention¹⁷⁸ improved grades for lower-achieving students in a nationally representative sample of U.S. high school students. However, the intervention’s sustained impact depended on peer norms: it was most effective in schools / classrooms where peer norms supported challenge-seeking, suggesting that a congruent social environment (“fertile soil”) is crucial for nurturing the adaptive beliefs introduced by psychologically wise interventions (“high-quality seed”, p. 368).

In a related study involving a large subset of this nationally representative U.S. sample, Yeager et al. (2022) explored how *teacher mindsets* moderated the effects of the online growth mindset intervention on ninth-grade students’ math grades, testing the

¹⁷⁸ The growth mindset module included in the AM course resembled closely the content and structure of the growth mindset intervention implemented by Yeager et al. (2019, 2022).

‘mindset-plus-supportive-context’ hypothesis. They found that the intervention was most effective in classrooms where teachers themselves endorsed growth mindsets. Students with fixed mindsets at baseline benefited most in classrooms with growth-mindset teachers, emphasizing the intersection of *individual vulnerability* and *environmental opportunity* as a key factor in intervention success. Conversely, students in classrooms with fixed-mindset teachers showed no comparable gains, highlighting the critical role of teacher mindsets as ‘affordances’ that allow students to act on the adaptive beliefs introduced by the intervention. By identifying the interaction between student and teacher mindsets, these findings advance the understanding of treatment-effect heterogeneity and underscore the need to address both individual and contextual factors to maximize the effectiveness of interventions.

Moving beyond peer norms and teacher mindsets, there is robust evidence that psychological interventions like the ones tested in the current project need also supportive *institutional cultures* in order to be effective. Walton et al. (2023) conducted a large-scale double-blind randomized controlled trial involving college students across 22 U.S. institutions to examine the effectiveness of a brief (10-30 minutes), online social-belonging intervention¹⁷⁹. The study found that the intervention significantly improved first year college completion, particularly among students from historically lower-achieving groups, but only in contexts where students’ opportunities to belong were adequately supported (‘belonging affordances’). These findings emphasize that the intervention’s success depends on both psychological (e.g., addressing belonging concerns) and contextual factors (e.g., adequate representation of teachers from diverse backgrounds, institutional messaging, inclusive practices), underscoring the need for complementary efforts to foster inclusive cultures and legitimate belonging opportunities for all student groups.

Although Walton et al. (2023) conducted their research among university students, the findings have important implications for school settings as well. The principles underpinning the social-belonging intervention are equally relevant in schools, where students also navigate challenges related to identity, inclusion, and belonging. School belonging concerns may be particularly relevant in the German education system, characterized by pronounced socio-economic and migration-related disparities that contribute to significant achievement gaps and inequitable access to educational opportunities. Disadvantaged students—whether due to socio-economic, migration-related, or other factors—may grapple with questions such as “Do I belong here? Does this school understand and care about my needs? Will doing well at

¹⁷⁹ The social belonging module included in the AM course resembled closely the content and structure of the social-belonging intervention implemented by Walton et al. (2023).

school actually help me in the future?”

Just as inclusive campus cultures and adequate belonging affordances have been shown to sustain intervention benefits in college, fostering inclusive school environments is important for nurturing students’ sense of belonging, fostering grit, and promoting academic achievement. This includes expanding existing efforts to provide targeted support for German language proficiency, better addressing the needs of students with (learning) disabilities, making parental involvement for disadvantaged families more accessible, and enhancing opportunities for students to build connections, feel valued, and actively contribute to the school community. While these measures (and many others not mentioned here) are already present in schools, scaling them up is essential to support student engagement and promote academic success. However, it stands to reason that teachers and schools alone often lack the capacity to scale up such efforts, given challenges like limited financial resources, shortages of teachers and social education workers, and a misalignment between school curricula and the real-world personal, educational, and labor market preparation needs of students in today’s Germany. Addressing these issues requires systemic changes and greater institutional and policy-level support to empower schools to meet the diverse needs of their students.

In sum, Walton and Yeager (2020) emphasize that the success and sustainability of psychological interventions like the ones implemented in this doctoral project depend also on the (psychological) affordances of the social context in which they are implemented. These interventions plant adaptive belief systems (‘seeds’), but their long-term impact relies on a conducive environment (‘soil’) that allows these beliefs to guide behavior. This metaphor is complemented beautifully by Bailey et al. (2017), who propose three related, yet distinct pathways that can lead to *long-term* intervention effects: targeting “trifecta” skills—those that are malleable, fundamental for long-term success, and unlikely to develop or change without external intervention¹⁸⁰, leveraging optimal developmental windows for “foot-in-the-door” interventions that provide timely boosts to help individuals navigate high-risk transitions and capitalize on opportunities for growth, and making sure that interventions “are followed by environments of sufficient quality to sustain normative growth” (p. 25).

While the current project targeted skills and beliefs that meet the trifecta criteria and

¹⁸⁰ The non-cognitive skills identified by Bailey et al. (2017) that align with the trifecta criteria—implicit theories of intelligence, self-concept, academic motivation, and self-regulation—happen to form the core of the present grit interventions through modules on growth mindset, values affirmation, sense of purpose, and self-control, respectively. Conscientiousness and grit are described by the authors as “fundamental but not readily malleable”, which explains their exclusion from the short trifecta list. Fortuitously, the model I proposed intervenes on grit by targeting exactly those skills identified by the authors as most likely to yield lasting benefits for adolescents.

capitalized on the sensitive timing of early adolescence, the capacity to ‘sustain’ students’ environments—encompassing peer climate, teacher behavior such as how they praise, challenge, or provide feedback to students, and broader school culture—remained beyond its scope. However, addressing teacher practices remains a crucial next step. Emerging research suggests that classrooms and schools naturally convey mindset messages, and when these messages align with adaptive beliefs such as a growth mindset, students often perform better academically (Rege et al., 2021). Future grit interventions must therefore prioritize not only skill-building at the individual level but also complementary contextual (classroom-level / school-level) changes to ensure the promoted perspectives are legitimate and actionable for all participants. Promising approaches to creating ‘enriched subsequent environments’ (fertile soil) could involve including teachers and social education workers in the process, aligning future school activities with the original intervention’s goals, and delivering interventions *at scale* to foster supportive peer norms, teacher mindsets, and positive classroom dynamics.

10.2 Future directions

10.2.1 Pragmatic Recommendations for Enhancing the Effectiveness and Long-Term Impact of Grit Interventions

Based on field observations during the grit courses and feedback from students in the focus groups (see section 9.6.6), several strategies can improve the appeal and effectiveness of grit-focused interventions for students, teachers, and schools.

Cohort-Wide or Secondary-School-Wide Implementation. First, an important recommendation is to make the intervention content available to all students within certain cohorts or across middle school (Grades 5 to 8). Universal implementation ensures that all students have the opportunity to (further) develop their individual grit while fostering a collective school culture that values academic effort. This approach would also reduce the prevalence of unsupportive *peer norms*, such as viewing academic success as ‘uncool’ or, in the case of students experiencing social identity threat, ‘not for kids like me’.

Second, a brief, *self-administered* online intervention is not the only approach—nor necessarily the most effective one—for fostering grit and other non-cognitive skills (Rege et al., 2021). For the current project, I opted for a direct-to-student method instead of a school-level treatment, partly due to feasibility constraints and because it did not necessitate teacher training, which can be resource-intensive. However, scaling up the web-based intervention while simultaneously enhancing its relevance in the school context could be achieved by embedding the online grit modules into existing school curricula, particularly within subjects like *Soziales Lernen* (Social Learning) or established initiatives such as Lions Quest, a life

skills program for youth widely implemented in Germany. Curriculum integration has two major advantages: first, teachers would play an important role in connecting the intervention's themes to students' daily academic experiences, offering practical guidance on applying these strategies, and reinforcing the learned principles. Additionally, by discussing these concepts with students, teachers themselves are exposed to the same key messages, reinforcing their own belief in them through the well-documented 'saying-is-believing' effect. This alignment of *teacher mindsets* with intervention goals, as shown by Yeager et al. (2022), is essential for ensuring the long-term impact of grit-focused interventions; second, embedding these modules into the curriculum allows students to revisit and internalize the strategies in a structured way, ensuring that the intervention themes remain relevant and actionable.

However, curriculum integration can be logistically challenging, especially if schools or teachers have limited flexibility to modify prescribed curricula, even for subjects (unjustly) considered 'peripheral', such as Social Learning. In such cases, offering the online modules as standalone activities at strategic time points—such as the start of the school year or before exams, as suggested by focus group participants—provides a feasible alternative. While this approach reduces teacher involvement and limits opportunities for integration into daily schoolwork, it remains a valuable option, as evidenced by the promising quantitative and qualitative findings of the current study. One potential benefit of these 'in-between' solutions is that they can maintain the autonomy-supportive tone critical to their effectiveness, whereas elaborate treatments with ample face-to-face components may be harder to scale and risk adopting a didactic, 'preachy' tone that can conflict with adolescents' prioritization of autonomy, status, and respect (Yeager et al., 2018). Teachers would still have some scope to reinforce the strategies outside the intervention sessions, and the practical implementation would be more straightforward for schools and may therefore encourage broader adoption.

Optimizing Modules for Engagement and Usability. To increase their appeal and effectiveness, the grit courses should be shorter and more focused. Simplifying the content by separating the modules (e.g., growth mindset, sense-of-purpose, WOOP goal-setting) would allow for sessions lasting 15–20 minutes—an ideal length according to student feedback. These modules could be delivered in manageable increments across a school term, ensuring students are exposed to both beneficial academic mindsets and the practical learning skills and strategies necessary to translate those adaptive beliefs into meaningful action.

Repeated exposure to grit-focused content across multiple school years requires strategic planning. Providing diverse content for each module to avoid redundancy, ensuring regular opportunities for application, and maintaining high-quality delivery are all critical for

long-term success. Developing two or three versions of each module, featuring diverse examples, texts, and videos, would maintain student interest while ensuring key concepts are revisited. Companion materials, such as workbooks or planners, could further support students in practicing and applying the learned strategies both in school and at home.

Leveraging Professional Design and Scalability. Ensuring that the modules are professionally developed and up-to-date with current e-learning design trends is crucial for student engagement and ease of use. Collaborating with professional e-content developers would also guarantee that the modules are technically robust and seamlessly compatible with all devices. High-quality online interventions, like those provided free of charge to schools and universities by the Stanford University-affiliated nonprofit PERTS, exemplify an accessible, research-based approach to delivering impactful content. In addition to student-focused programs, PERTS offers companion resources for teachers to assess and cultivate classroom conditions that catalyze engagement and learning, making these resources particularly valuable for fostering environments that align with intervention goals. While for-pay programs such as Brainology® offering class or school licenses for one school year are another potential option, their cost and the additional effort required for teachers / schools to implement them may make them less appealing in the German context. Future efforts should focus on securing funding to professionally develop and host these resources, with the aim of making them available to schools and teachers at no additional cost.

Regular Evaluation for Sustained Effectiveness. Finally, any grit-focused program should ideally include mechanisms for regular evaluation to ensure its effectiveness over time. Rigorous, large-scale, double-blind, randomized controlled trials like those conducted in the U.S. for growth mindset or social belonging interventions offer a possible model for assessing intervention impacts. While similar evaluations are still lacking in the German context, where interventions of this nature remain relatively small and localized, this study represents a promising foundation for future large-scale efforts to rigorously assess and refine grit interventions in this educational setting.

Implementing schools can also conduct internal evaluations of program effectiveness, leveraging their daily access to students and teachers, as well as school records and grades, resources that are more challenging for external researchers to obtain. While these evaluations are different in nature and purpose than those carried out in pre-registered, peer-reviewed scientific studies, they can provide valuable insights that are sufficient for the schools' needs.

By taking into account these practical considerations, future grit interventions can be made even more appealing, scalable, and effective, addressing individual student needs while

ideally fostering positive spillover effects on school culture, thereby creating the fertile ground necessary for adaptive beliefs to take root and flourish.

10.2.2 Ideas for Advancing Grit Research

Although the present research addressed numerous theoretical and methodological limitations in previous grit studies (see sections 2.8.1 and 5.1), several questions remain open for future investigation. A particularly pressing issue is the measurement of grit, especially given the differences observed in this study between self-reported general grit and school grit. In the current sample, school grit functioned as a higher-order construct with two interrelated lower-order facets at both Time 1 and Time 2, while general grit only exhibited this structure at Time 1. At Time 2, there was no evidence of a latent construct or (significant) correlation between the facets of general grit, despite the scales being identical apart from the domain-specific wording. These psychometric differences raise concerns about the robustness of the grit scales. Additionally, the all-negative wording of one facet remains problematic (see section 2.5.2) and requires refinement in future iterations of the scale.

The lack of measurable change in self-reported grit following the intervention could indicate an absence of effects, but it could also suggest that the measure itself was insufficiently sensitive to detect small shifts in students' self-concept. Research has also shown that the grit self-report measure is susceptible to reference bias (Lira et al., 2022) and social desirability bias (DiMenichi & Richmond, 2015), underscoring the need to complement it with additional assessment methods. Consequently, future grit studies should prioritize multisource measurements. Behavioral instruments, such as the math game tested in this study but ultimately excluded from the analyses (Alan et al., 2019), or the Academic Diligence Task (Galla et al., 2014)—which evaluates the willingness to exert effort on academic tasks that are tedious in the moment but essential for long-term success—serve as valuable tools for assessing perseverance. Notably, teacher-reported grit has been found to predict students' behavioral outcomes and grade progression more effectively than either self-reported or behavioral measures (Boon-Falleur et al., 2022). Therefore, intervention studies would benefit from a triangulated approach, combining self-reports, teacher-reports, and behavioral measures to provide a more comprehensive evaluation of grit.

Future research should continue to investigate the psychological antecedents of grit. The theoretical model proposed in this research posits that individuals require both adaptive mindsets and the necessary skills and strategies to exhibit gritty behavior, which in turn leads to positive outcomes. This model is grounded in research linking grit to other psychological resources and aligns with frameworks of grit, perseverance, and academic tenacity in school

settings. It further aligns with the theoretical framework proposed by Stephens et al. (2012), who argue that desirable, malleable selves or identities—such as viewing oneself as a ‘learner’ or ‘good student’, akin to *mindsets*—require ongoing support from both individual characteristics, akin to *skills* (e.g., self-control, learning strategies), and structural conditions (e.g., high-quality schools) to sustain meaningful behavior change. While the quantitative and qualitative findings of this study lend promise to this model, further validation with larger samples in German schools is needed. Incorporating the recommendations for improvement outlined in the previous section into future iterations of the model would enhance its applicability. At the same time, other promising approaches to fostering grit, such as interventions focused on hope, mindfulness, or explanatory styles, merit further investigation.

The moderating role of performance domains also requires further exploration. In this study, it was addressed only by asking students questions about personally meaningful goals and their subsequent achievement. Future research should explore more systematically the types of situations, tasks, or goals for which grit and gritty behavior prove most beneficial. Moreover, it is important to determine whether school-based grit interventions have domain-transcending effects on personal interests and hobbies, interpersonal relationships, or health.

Finally, the moderating role of ability warrants ongoing scrutiny. In this study, the cross-sectional association between school grit and GPA was strongest among low-ability students, followed by high-ability students, and least evident among those with average ability. The intervention seemed to yield the most significant benefits for low-performing students while acting as a protective factor for higher-performing peers. These findings raise important questions about whether low-ability students leverage grit as a compensatory mechanism and how grit interventions can be tailored to maximize their effectiveness across the ability spectrum. Moreover, the observed overlap between low academic performance and socio-educational disadvantage in this sample challenges Gil-Hernández’s (2021) assertion that non-cognitive skills compensate for low cognitive ability only among students from high-SES backgrounds. Future research should therefore reexamine the complex interplay between ability, socio-educational disadvantage, and grit.

10.2.2 Embracing the Radical Middle

The ‘seed and soil’ metaphor (Walton et al., 2023; Walton & Yeager, 2020; Yeager et al., 2019, 2022), as well as the three pathways for achieving long-term intervention benefits—‘trifecta’ skills, foot-in-the-door practices, and sustaining environments (Bailey et al., 2017)—highlight the importance of seeds taking root in soil that provides the suitable *psychological* affordances supporting those new ways of interpreting and responding to events. These are

contexts that make the promoted ways of thinking legitimate, actionable, and sustainable. In this regard, students' home environments—shaped by parenting styles—play a critical role in affording or constraining certain (academic) beliefs and behaviors. Within the school setting, peer norms, teacher mindsets and support, and institutional culture serve as essential psychological affordances. But what about the *structural conditions*—such as school quality, resource availability, and school safety—that are necessary to ensure that interventions targeting non-cognitive skills can lead to sustained behavior change (Stephens et al., 2012)? In other words, what about the structural factors within the education system and broader society that prevent certain students from accessing academic-track schools, achieving higher-level school-leaving certificates like the Abitur, or obtaining quality vocational training?

Section 2.7.2 of the literature review highlighted critics' concerns that focusing on grit reinforces harmful social structures by placing the burden of success on students while neglecting systemic barriers, such as socioeconomic disparities and discrimination. This perspective aligns with the *structural* model of human behavior (Stephens et al., 2012), more often the focus of sociologists, which attributes academic achievement and other outcomes primarily to environmental conditions, such as access to resources and school quality, and seeks to address inequality by improving these structural conditions. However, a key limitation of this model is that it does not fully account for individual characteristics—such as skills, motivation, or self-concept—that influence how different people interpret and respond to identical environments, thereby overlooking the interplay between individual agency and structure. Conversely, the individual model of behavior, more often the focus of psychologists, attributes behavior primarily to personal traits and characteristics, but tends to underestimate the role structural factors play in producing and perpetuating inequality.

Given that both structural and individual models do a relatively poor job, on their own, in explaining inequality and offering effective intervention strategies (Stephens et al., 2012), I argue, borrowing Bell-Robinson's (2016) concept, that we must embrace the 'radical middle' when it comes to teaching grit in schools. Bell-Robinson describes this middle ground as 'radical' because acknowledging the validity of both perspectives—personal responsibility and systemic barriers—challenges the tendency to oversimplify the debate. Grit undeniably holds value for personal growth and achievement, as explored in detail in section 2.4 Why Grit Matters. This study reinforces grit's relevance for academic outcomes: school grit shows a strong positive association with GPA (Chapter 7); grit interventions appear particularly beneficial for lower-ability and disadvantaged students (Chapter 8); and their impact extends beyond measurable school performance, as evidenced by focus group discussions (Chapter 9).

Thus, these findings provide ample evidence for Bell-Robinson's assertion that "there is goodness in grit" (2016, p. 16), but it should not be considered a cure-all for achievement gaps or other symptoms of social injustice. Teaching students to persist through every challenge without considering the nature of the obstacle leaves no room for critical reflection on whether grit is the appropriate response. When confronted with external barriers like harassment or discrimination, seeking help is often a far more appropriate response than gritting one's teeth—to borrow a grit-related idiom—and trying to get over the injustice.

Bell-Robinson calls for distinguishing between internal barriers—such as a lack of motivation, where grit is appropriate and should be fostered—and external barriers, such as inequitable practices, which require structural change rather than individual perseverance. Throughout my interactions with students and teachers at both schools involved in this research, it became evident that certain deficiencies—systemic flaws, if you will—cannot be remedied by curriculum changes alone, no matter how well-designed or frequently delivered the content may be. Grit-focused interventions can offer meaningful support to students but cannot, and should not, be seen as a substitute for comprehensive school development and policy changes designed to address educational inequality. Research on grit, and on non-cognitive skills more broadly—whether framed as socioemotional learning, soft skills, or character education—can contribute a few pieces of the larger puzzle: nurturing adaptive mindsets, building individual skills, and, ideally, fostering supportive, congruent environments. Therefore, it is important to identify and utilize those pieces that make the greatest possible difference. Embracing the radical middle, as Walton et al. (2023, p. 504) aptly state, involves recognizing that "psychological and structural reforms are not substitutes for one another but can work together to promote positive change".

10.3 Evaluation

10.3.1 Limitations

Understanding the constraints of this study is necessary for evaluating the validity of its conclusions and their potential applications. Since phase- / strand-specific limitations have been addressed in detail throughout this dissertation, along with steps taken to mitigate these challenges—for example, in section 4.5.1 for the pilot study, section 5.8.1 for the quantitative strand, and section 9.8 for the qualitative evaluation—I will not revisit them at length here. Instead, this final evaluation highlights two limitations that I consider particularly important, especially in terms of their implications for improving the design, implementation, and overall effectiveness of future school-based grit interventions.

Sampling and Study Design. Both the pilot and main studies relied on voluntary

participation, introducing the risk of self-selection bias. Although the main study achieved a relatively high participation rate of 75%, the opt-in approach may have led to an overrepresentation of motivated students. Moreover, while the sample was otherwise fairly representative of the target population—7th- and 8th-graders from comprehensive secondary schools in Bremen—the voluntary nature of participation may have resulted in systematic differences between participants and non-participants, including disparities in socioeconomic background, parental involvement, academic achievement, or baseline grit levels. These differences could have influenced the outcomes and limited the generalizability of the findings. Despite efforts to mitigate this issue, such as incentivizing the return of signed parental consent forms, the convenience sampling approach remains a limitation of the study.

The random assignment of entire classes to intervention conditions, though practical and necessary in this school context, could have restricted the ability to draw robust causal inferences. Baseline imbalances between conditions, even if statistically non-significant, may have nonetheless impacted how groups responded to the intervention and may have reduced statistical power. This concern is particularly pertinent when trends in the data show one group consistently scoring higher or lower on key measures, as observed with the LSS and AM groups for self-reports and GPA. Although baseline differences were controlled for, this approach has its own challenges. Including a large number of baseline covariates increases model complexity, raising risks such as insufficient power, multicollinearity, and overfitting, which can obscure true intervention effects and limit the generalizability of the findings. The absence of individual-level random assignment also leaves room for the possibility that *unmeasured* confounding variables influenced the results.

Additionally, sampling entire classes, combined with voluntary participation, resulted in unequal group sizes. This challenge could not be addressed by redistributing students across groups, as participation was confined to original class assignments. Unequal group sizes tend to decrease statistical power, particularly for smaller groups, and complicate analyses by increasing the variability of standard errors across conditions. Smaller groups, in particular, are more vulnerable to the impact of outliers or unique class dynamics, potentially affecting the reliability of the findings.

These limitations highlight the importance of considering alternative sampling and assignment strategies in future research. For instance, embedding the grit intervention within a school-wide project could ensure that all students are exposed to the program, thereby eliminating the issue of self-selection. Furthermore, employing a fully experimental design, where feasible, would enhance the ability to isolate the effects of the intervention and provide

more reliable evidence for its effectiveness. Finally, incorporating strategies to standardize group sizes, such as combining data across multiple schools or cohorts, could enhance the robustness of findings and reduce the risk of unequal group effects skewing results.

Teacher-Assigned Grades as a Main Dependent Variable. A second notable limitation of this study, already addressed briefly in section 5.8.1, is the exclusive reliance on teacher-assigned grades as a measure of performance. While course grades or GPA are common indicators of performance in education interventions and are generally highly correlated with standardized test scores (Duckworth & Allred, 2012), their validity is undermined by several factors. First, grades reflect more than just students' content knowledge; they are influenced by factors such as classroom behavior, participation, and effort. For instance, rewarding obedient behavior with higher marks diminishes their precision as a measure of objective skill. Second, grades are prone to teacher bias, inconsistencies in grading practices and standards (even within the same school), and classroom dynamics, all of which contribute to variability and limit their reliability across different contexts.

In the German comprehensive school system, the complexity of the grading structure further complicates the use of grades as an outcome variable. The coexistence of basic, advanced, and undifferentiated courses means that grades are not directly comparable across course levels. Transitions between levels—such as moving from a basic to an advanced course—can result in grade shifts that reflect changes in grading standards rather than true changes in student ability or performance. This makes it challenging to interpret grade-based outcomes without additional adjustments. Moreover, school grades in this context are ordinally scaled, yet they are treated as interval-scaled in research to facilitate parametric analyses. This assumption introduces another layer of complexity, as the ordinal nature of grades does not inherently support the mathematical operations required by such analyses.

To address these challenges, this study implemented several measures to enhance the comparability and interpretability of grade data. Adjustments were made to account for differences in course levels using data-derived indicators such as the 'change factor' and 'ability differential', which normalized grades from basic courses to align with those from advanced courses. Z-standardization was applied within each grade level and course type to reflect students' relative standing among their peers. Composite GPA scores were then calculated based on these standardized grades, ensuring that the final measure accounted for differences in course levels and grading standards. This approach provided a more equitable basis for evaluating the intervention's impact on students' academic trajectories. Moreover, GPA data was supplemented with additional measures of achievement, such as teacher

evaluations of student progress and long-term educational attainment. However, as detailed in Chapter 8, the grit interventions did not have significant effects on these additional measures.

Despite their apparent shortcomings, course grades and GPA should not be dismissed in favor of standardized tests, which focus solely on content knowledge and skills. Evidence suggests that grades may offer *unique advantages* as outcomes in interventions targeting attributes like grit. Compared to standardized test scores, course grades are more sensitive to individual differences in traits related to effortful control, such as self-discipline, time management, and persistence. For example, research indicates that self-control better predicts changes in grades over time than IQ, and conscientious behaviors—including class attendance, timely completion of assignments, and avoiding distractions—are more strongly associated with grades than standardized test performance. Moreover, high school GPA has consistently outperformed standardized test scores in predicting key outcomes such as class rank, high school graduation, college GPA, and college graduation (Duckworth & Allred, 2012). These findings highlight the ability of course grades to capture a broader spectrum of personal and behavioral qualities essential to academic success, making them particularly relevant for evaluating interventions aimed at fostering grit and other non-cognitive skills.

Future studies should therefore aim to **combine** multiple measures, including course grades / GPA, informant (teacher) reports on students' grit and behavioral school engagement, standardized test scores, and indicators like advanced course enrollment, to achieve a more comprehensive assessment of intervention outcomes. Such a multidimensional approach would improve the validity, reliability, and generalizability of findings, addressing many of the concerns related to relying on grades as the primary DV. Incorporating standardized test scores, where available, supports comparisons of intervention outcomes across diverse settings, such as various types of secondary schools, German states (Länder) with different school systems and standards, and even international contexts (e.g., using PISA test scores). Additionally, using test scores allows researchers to compare their results with established benchmarks for intervention effects derived from meta-analyses and systematic reviews. These benchmarks enable a clearer interpretation of the magnitude of an intervention's impact, facilitating transparent communication of findings to the research community.

10.3.2 Strengths and Contributions

This research project makes significant theoretical, methodological, and practical contributions to the field of grit research and intervention studies. Key strengths have been discussed throughout earlier chapters, including addressing critical gaps in the literature (sections 2.8.1, 2.8.2, and 5.1), introducing a streamlined theoretical model of the grit-

performance relationship (section 3.3), and employing innovative methods within a rigorous, multi-phase mixed-methods design (notable contributions detailed in sections 4.5.1, 4.5.2, and 5.8.2). This final evaluation highlights a few contributions that hold particular relevance for advancing future efforts to foster grit in educational settings.

Theoretical Contributions. A key theoretical contribution of this study lies in its exploration of grit's psychological antecedents, conceptualized as a combination of *beneficial mindsets* and *skills*. By examining how these constructs underpin grit and their potential as intervention targets, the research advances our understanding of the mechanisms that enable perseverance in the pursuit of long-term goals. This study's causal model of grit emphasizes the interplay between academic mindsets (growth mindset, sense of purpose, belonging) and learning skills and strategies (deliberate practice, self-control, goal-setting), proposing that these factors collectively enable gritty behaviors that drive academic success. This simplified framework provides a practical, evidence-based guide for designing future grit interventions.

The study also advances the understanding of grit's domain specificity through the integration of both domain-general and school-specific measures. A direct comparison of their associations with academic performance and self-selected goal achievement reveals that school grit is a significantly stronger predictor of success within the school context. This dual-measure approach addresses longstanding questions about whether grit operates uniformly across contexts, thereby enriching the theoretical discourse surrounding grit's applicability.

Lastly, this research brings focus to the experiential and subjective dimensions of grit, which are consistently overlooked in the literature. By examining participants' reflections on the many interplaying factors—both intrapersonal and contextual—that influenced their academic trajectories post-intervention, the study goes beyond the abstract notion of grit as captured by an eight-item scale. Instead, it delves into *grit personified*: what grit truly looks like and how it operates in the lives of secondary school students within the context of their classrooms and schools. This perspective offers a richer and more nuanced understanding of the beliefs, behaviors, and contextual dynamics that shape grit-related outcomes.

Methodological Contributions. Methodologically, this study distinguishes itself by employing a rigorous, theory-driven approach to intervention design and evaluation, guided by a user-centered design philosophy. Drawing on the emerging field of applying design thinking to social-psychological interventions, this research integrated feedback from both teachers and students to tailor the grit interventions specifically for secondary school students in Germany. The iterative development process included extensive feasibility and usability testing, ensuring that the interventions were practical, engaging, and relevant to the target

population. By detailing this process, the study advances methodologies for adapting and developing intervention materials to address the specific needs of diverse student populations, offering a replicable model for creating web-based tools in real-world educational settings.

This study's longitudinal design, with multiple follow-up points spanning a five-year period, represents a rare and significant contribution to grit research. The extended timeline facilitated a comprehensive evaluation of both the short-term and long-term effects of the grit interventions, including their potential influence on educational attainment. By incorporating diverse outcome measures—self-reports, GPA, teacher evaluations, progress on self-selected goals, and students' personal accounts of the intervention's impact—the study provides a multidimensional perspective on intervention efficacy. Moreover, it offers a textbook example of treatment-effect heterogeneity. For instance, the finding that grit interventions can improve outcomes without necessarily increasing self-reported grit may be relevant for advancing theory (especially surrounding grit measurement) and optimizing intervention design.

Practical Contributions. This project represents, to the best of my knowledge, the first effort to foster grit within a school setting in Germany. The positive effects of the interventions on student GPA and self-selected goal achievement—outcomes not observed in the control group—demonstrate that key mindsets and behaviors associated with grit can be cultivated or reinforced through brief, carefully designed web-based content, even without the involvement of a skilled teacher or coach. By creating two novel interventions—one centered on academic mindsets and the other on skills and strategies—this study offers practical tools with significant potential for broader application. With further professional refinement, the online grit modules could be implemented, in principle, across German-speaking countries, with (minor) modifications to suit different age groups or local contexts. The anticipated scalability and cost-effectiveness of the grit interventions make the study particularly relevant to practitioners, including school administrators and teachers, who can leverage these tools to help students enhance their academic performance and achieve their goals.

Another practical benefit of this study is the measurable impact of the grit interventions on students' academic performance, alongside the provision of effect sizes that quantify this impact and offer a valuable basis for comparisons across studies and contexts. Most benchmarks for effect sizes come from U.S.-based meta-analyses, which predominantly use test scores rather than grades. In Germany, such benchmarks are even scarcer; the only available reference (Brunner et al., 2024) also relies on standardized test scores. Although grades and test scores are often highly correlated (Duckworth & Allred, 2012), caution is warranted when interpreting outcomes based on these different measures. This research adds

to the limited body of evidence in Germany examining intervention effects on grades / GPA.

Recent research highlights various ways to conceptualize effect sizes in education interventions conducted in real-world settings, which are typically modest compared to those observed in laboratory studies. For instance, Kraft's (2020) benchmarks for effect sizes in education, already introduced in Chapter 8, define small effects as < 0.05 , medium effects as 0.05 to < 0.20 , and large effects as ≥ 0.20 *SD*. Studies using broad measures like GPA often yield smaller effect sizes than those focusing on narrower outcomes like subject-specific grades or test scores, with median effect sizes of 0.10 and 0.17 *SD*, respectively. A different perspective on effect sizes is provided by U.S. studies on growth mindset interventions using grades or GPA as outcomes, which report improvements ranging from 0.10 to 0.16 *grade points or GPA units* for lower-achieving high school students (Yeager et al., 2019, 2022; e.g., Yeager, Walton, et al., 2016). Additionally, some studies express intervention impacts in terms of *percentage point gains*. Noted psychologist Daniel Kahneman noted that, "what you can hope for is what is called practically significant improvement, which is usually a few percent. If you get a few percent at relatively low cost, that's a success" (cited in Dubner, 2017). Together, these perspectives illustrate that while effect sizes in applied education research often appear modest, they are still meaningful, especially when the interventions are scalable, rigorously assessed, and linked to consequential outcomes such as grades.

In my own study, Cohen's d_s values ranged from 0.013 (LSS condition, T1 to T2) to 0.191 (Cluster 1, COMB condition, T1 to T2) and 0.200 (AM condition, T1 to T5), with the latter translating to about 4% improvement in GPA compared to the control group over a two-and-a-half-year period. Framing the latter finding, for instance, in the context of the benchmarks discussed above highlights its significance: the AM treatment's effect is at the threshold of being considered large and falls within the range of Kahneman's "practically significant improvement". Given that adolescent behavior-change interventions often yield null effects, even when resource-intensive (Rege et al., 2021), achieving an improvement of this size—particularly at low cost—is a noteworthy achievement and demonstrates the potential for scalable, cost-effective grit interventions to improve academic outcomes.

Finally, a third practical contribution of this study lies in its focus on grit as an important resource for socially disadvantaged and lower-ability students (with boys in these groups being particularly at risk for poor academic outcomes), who often face significant barriers to academic success within the German education system. These barriers may stem partly from early tracking into secondary school tracks, disparities in school and teacher quality, and unequal access to resources—challenges that are especially pronounced for

students with a migration background. The findings reveal that grit is more strongly associated with GPA for students with lower socio-educational advantage (SEA) and lower academic ability, suggesting that grit may act as a compensatory mechanism. The longitudinal analysis further highlighted the targeted effectiveness of the interventions for disadvantaged / lower-ability students, who showed meaningful GPA gains. By potentially enabling students to address certain internal challenges, such as a fixed mindset or lack of motivation often associated with recurrent negative feedback, grit interventions could help mitigate some of the adverse effects arising at the intersection of personal, educational, and societal factors.

10.4 Conclusion

This research provides a comprehensive examination of grit's role in fostering academic success, offering both theoretical and practical insights grounded in evidence from Bremen's largest comprehensive secondary school. The integration of quantitative and qualitative findings highlights the importance of grit as a multifaceted resource. Preliminary evidence suggests that both academic mindsets and learning skills and strategies are likely to play a significant role in grit development and grit-related outcomes.

At its core, this project underscores the dual nature of grit as a personal resource and a target for intervention. The quantitative findings demonstrated that grit—particularly school-specific grit—is strongly associated with academic outcomes such as GPA and school goal achievement, especially for students facing socio-educational disadvantage or lower academic ability. These findings were enriched by the qualitative strand, which revealed the complex interplay between individual mindsets, behaviors, and contextual factors like teacher support and school system constraints in shaping students' academic trajectories. Together, the results emphasize that fostering grit requires more than individual effort; it calls for environments that affirm and sustain the psychological resources needed for *passion and perseverance*.

Looking ahead, this study lays the groundwork for advancing grit research and practice in several ways. By advocating for context-sensitive interventions that address both individual and environmental barriers to academic success, it calls for a holistic approach to student development. It also highlights the importance of long-term evaluation and multidimensional outcome measures to capture the full spectrum of intervention effects. Its theoretical framework, intervention development methodology, and the resulting web-based grit courses serve as valuable resources for future efforts aimed at fostering grit and empowering students to overcome challenges and achieve their goals. By situating grit within the broader conversation about educational equity, the research calls for continued efforts to bridge gaps in opportunity and support, ensuring that all students can thrive.

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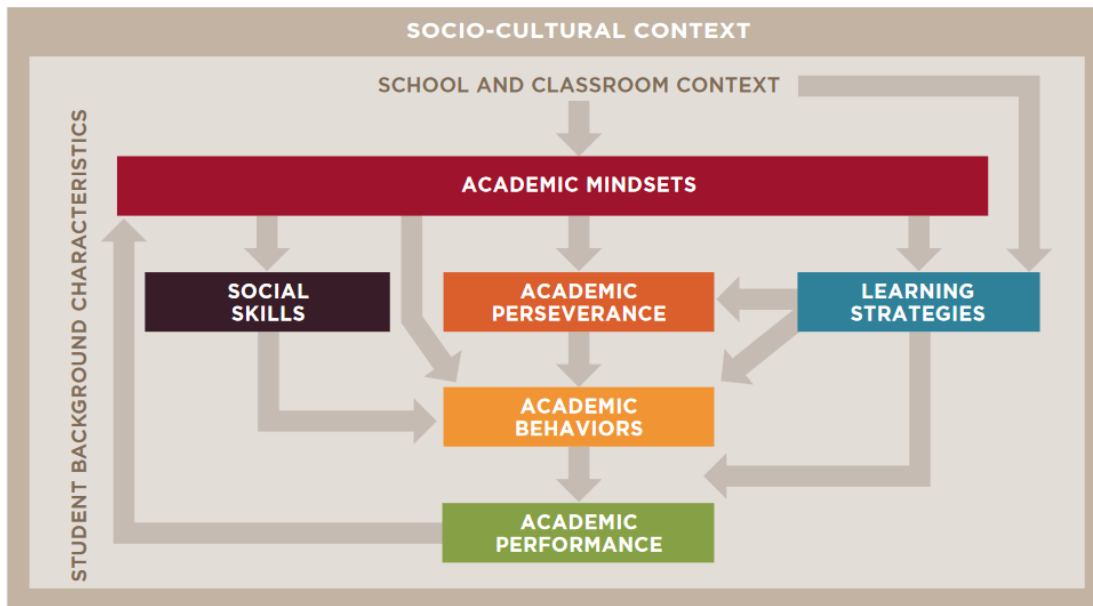
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Appendix A

Three Models of Non-Cognitive Factors in the School Context

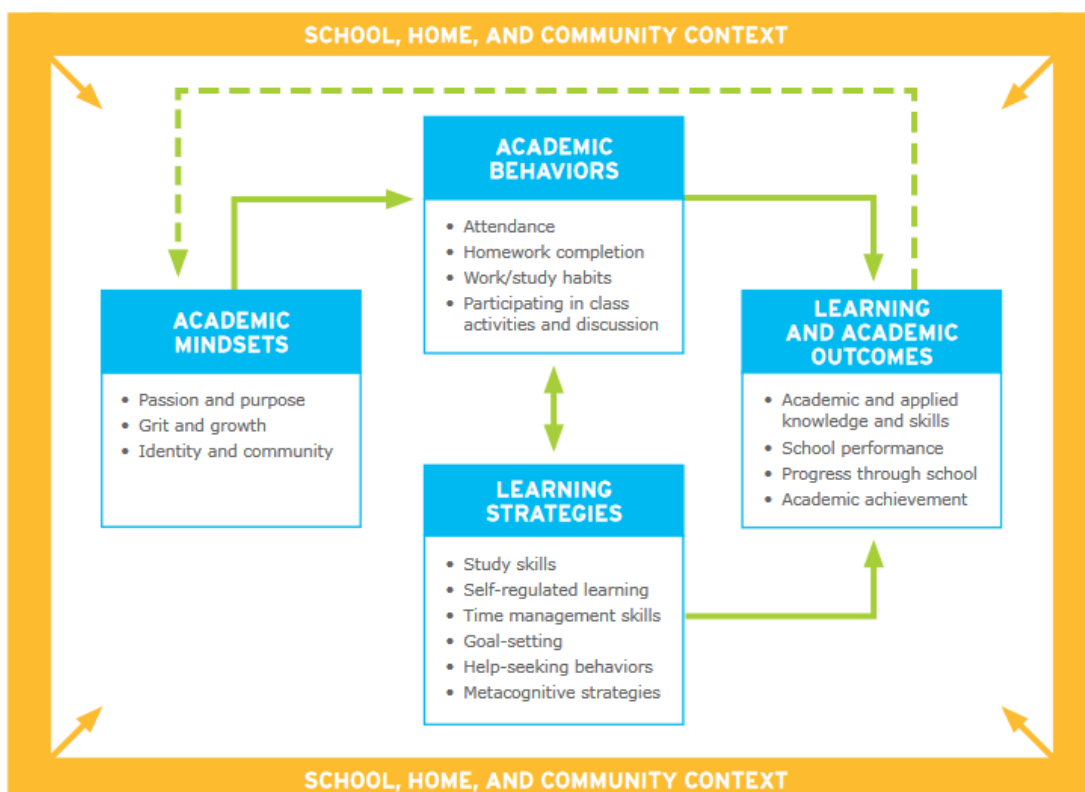
Farrington et al. (2012)

A Hypothesized Model of How Five Noncognitive Factors Affect Academic Performance within a Classroom/School and Larger Socio-Cultural Context



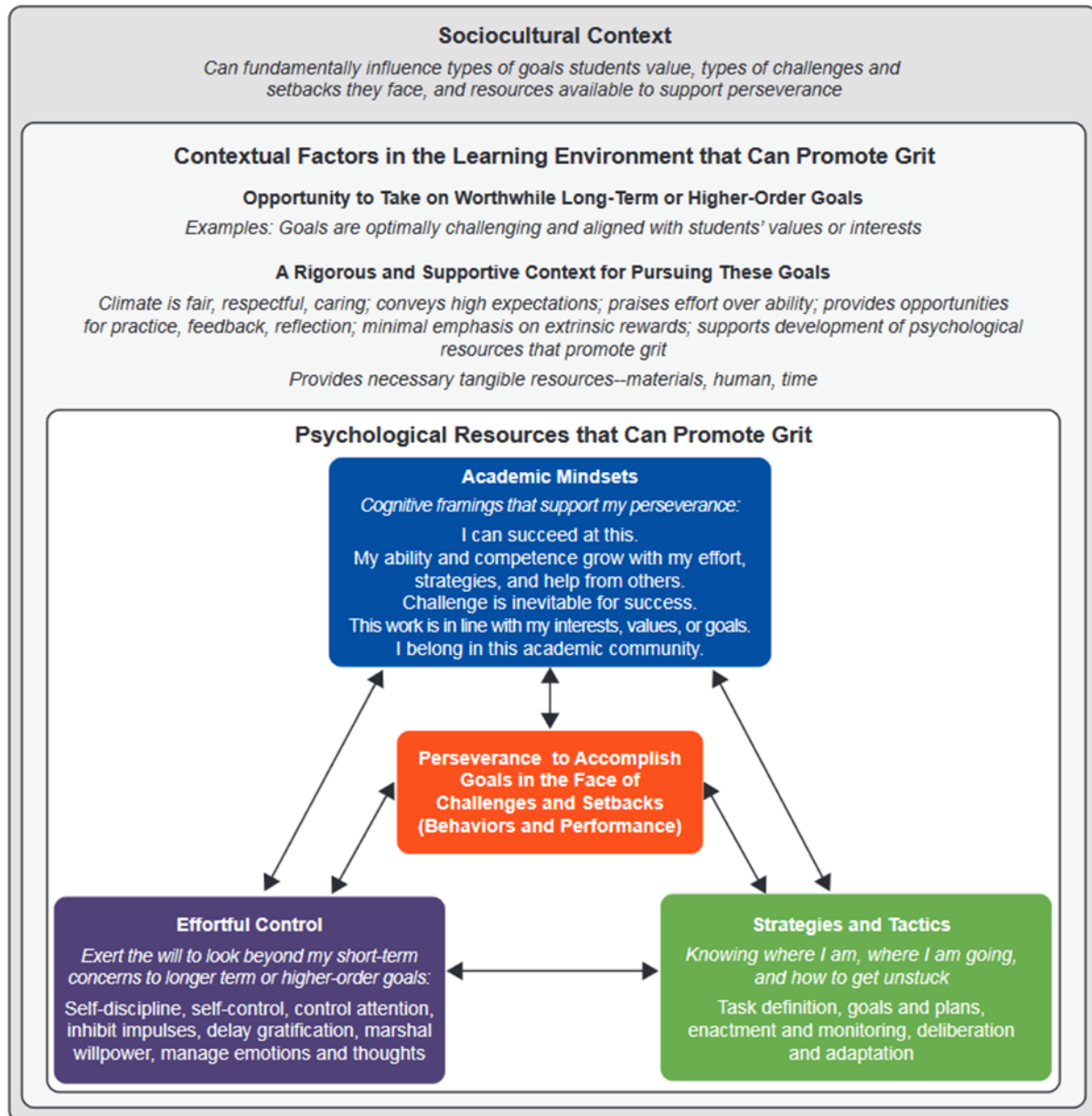
Snipes et al. (2012)

FIGURE 2. Theory of Action



SRI International (2018)

Hypothesized Model of Grit, Tenacity, and Perseverance, and the Contextual Factors and Psychological Resources that Promote Them



Appendix B.1

School Consent Form (NOG)

Von:

Name der Schule: **Neue Oberschule Gröpelingen**

Schulleiterin: **Frau Sabine Jacobsen**

an

Cristina Greculescu

Affiliated Ph.D. Fellow, Bremen International Graduate School of Social Sciences (BIGSSS)

Campus Ring 1 (South Hall), 28759 Bremen

E-Mail: cgreculescu@bigsss-bremen.de

Tel: 017682030840

betrifft: **Das Forschungsprojekt mit dem Titel „Teaching Grit: Examining the Effects of a School-Based Intervention to Foster Grit“**

Kurzbeschreibung (*weitere Informationen zum Thema und zur Relevanz dieser Studie finden Sie in dem Infobrief, den Sie bereits erhalten haben*)

Im Rahmen einer Doktorarbeit in Psychologie an der Bremen International Graduate School of Social Sciences (BIGSSS) werden mit einigen LehrerInnen und SchülerInnen der Klassen 7 und 8 vier Fokusgruppen (Gruppendiskussionen) durchgeführt, um zwei Online-Kurse zu entwickeln, die sich auf Lern-Denkweisen und -Strategien konzentrieren. Anschließend werden diese Inhalte mit SchülerInnen im Pilotversuch getestet. Für den Pilotversuch werden ca. 50 SchülerInnen der Klassen 7 und 8, die nicht an der Entwicklung der Inhalte beteiligt waren, **einen Fragebogen ausfüllen, an zwei Online-Kurse teilnehmen, und ein Rechnen-Spiel spielen.**

Die folgende Unterstützung wird von der Seite der Schule erwünscht: Klassenzimmer oder (Test-) Räume mit PCs oder Tablets bereitstellen, die SchülerInnen für den Zweck der Intervention aus dem Unterricht entlassen und die (anonymisierten) Schulnoten der SchülerInnen zur Verfügung stellen. Eine Lehrerin bzw. ein Lehrer wird gebeten, bereitwillige TeilnehmerInnen, die sehr gut Deutsch sprechen, für die Fokusgruppen auszuwählen und die Einverständniserklärungen für die Eltern aller SchülerInnen, die an der Studie teilnehmen möchten, zu verteilen und wieder einzusammeln. Alle Einverständniserklärungen (von Eltern, Schülern und Lehrern) werden dann in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt.

Diese Untersuchung wurde durch die Senatorin für Kinder und Bildung genehmigt. Die Projektverantwortlichen tragen dafür Sorge, dass alle erhobenen Daten streng vertraulich behandelt und ausschließlich für wissenschaftliche Zwecke verwendet werden. Insofern dies nicht anders gesetzlich bestimmt ist oder die Schulleitung im Einzelfall ausdrücklich eingewilligt hat, erfolgt keine Übermittlung von erhobenen Daten an Dritte. Nach der Datenerhebung werden die anonymisierten Daten zu Zwecken der wissenschaftlichen Qualitätssicherung für 10 Jahre auf dem passwortgeschützten BIGSSS-Server gespeichert und danach datenschutzgerecht gelöscht. Die Forschungsergebnisse werden in wissenschaftlich üblicher Form veröffentlicht. Durch die Anonymisierung der Daten wird gewährleistet, dass keine Rückschlüsse auf persönlichen Daten gezogen werden können.

Fragen zu dieser Studie können per E-Mail an cgreculescu@bigsss-bremen.de gerichtet werden. Allgemeine Fragen zum Datenschutz können an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) gerichtet werden.

Die Einverständniserklärung befindet sich auf der zweiten Seite →

Einverständniserklärung der Schulleitung

Die für die Durchführung verantwortliche Person hat uns schriftlich und umfassend über die beabsichtigte Untersuchung informiert.

Wir sind damit

☐ einverstanden

☐ nicht einverstanden

- dass die Gruppendiskussionen mit den betreffenden LehrerInnen und SchülerInnen unter deren Einverständnis (und des der Erziehungsberechtigten)
 - aufgenommen werden (Audio), verschriftlicht werden, anonymisiert werden, anonymisiert gespeichert werden und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung verwendet werden
- dass die durch Fragebögen erhobenen Daten von SchülerInnen unter deren Einverständnis (und des der Erziehungsberechtigten)
 - anonymisiert gespeichert werden und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung verwendet werden.
- und dass diese personalisierte Einverständniserklärung 10 Jahre in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt wird und anschließend vernichtet wird.

Uns ist bekannt, dass wir die Einwilligung jederzeit ohne Angabe von Gründen widerrufen können und, dass eine Nichtteilnahme keinerlei Nachteile für unsere Schule mit sich bringt.

Ort, Datum

Unterschrift, Stempel der Schule

Appendix B.2

Focus Group Consent Form for Parents / Legal Guardians (NOG)



Projektleitung: Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
Campus Ring 1, 28759 Bremen; Tel.: 017682030840
Email: cgreculescu@bigsss-bremen.de



Elterninformation

Liebe Eltern, liebe Erziehungsberechtigte,

Im Rahmen einer Studie werde ich mit einigen LehrerInnen und SchülerInnen der Klassen 7 und 8 mehrere **Gruppendiskussionen** durchführen, um einen computergestützten Kurs über Lernmotivation zu entwickeln. Ihr Kind wurde aufgrund seiner hervorragenden Deutschkenntnisse ausgewählt, an den Diskussionen teilzunehmen.

Erfahrungsgemäß macht die Teilnahme an einer Studie den SchülerInnen Spaß. Außerdem finden die Gruppendiskussionen nur an zwei Montagnachmittagen (11.2.19 und 4.3.19) von 14:30-17:30 Uhr statt, sodass der Schulalltag Ihres Kindes durch die Studie so wenig wie möglich gestört wird. Das Vorgehen wurde mit der Schulbehörde und der Schulleitung abgesprochen.

Die **Anonymität** der Kinder wird jederzeit sichergestellt. Im Untersuchungsbericht werden keine Angaben zu einzelnen SchülerInnen gemacht. Wir versichern Ihnen, dass die erhobenen Daten nicht an Dritte weitergegeben werden. Sie werden nach Abschluss des Forschungsprojektes gemäß den Bestimmungen der BIGSSS/Universität Bremen gespeichert und danach vernichtet.

Selbstverständlich ist die Teilnahme Ihres Kindes an den Gruppendiskussionen **freiwillig**. Eine Nichtteilnahme hat keine Nachteile für Ihr Kind. Sie dürfen die Einwilligung jederzeit ohne Angabe von Gründen widerrufen. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Mit Ihrem Einverständnis tragen Sie zum Gelingen der Studie und zu einer weiteren Verbesserung des Schulalltags bei. Bitte unterschreiben Sie daher die Einverständniserklärung und geben Sie den Zettel Ihrem Kind **bis zum 11.02.2019** mit in die Schule zurück. Sollten Sie zuvor noch weitere Fragen haben, so kontaktieren Sie mich gerne telefonisch oder über die oben stehende E-Mail Adresse.

Mit freundlichen Grüßen,
Cristina Greculescu

----- (hier abtrennen) -----

Einverständniserklärung zur Teilnahme an der „Lernmotivation-Studie“

Ich bin damit

☐ einverstanden

☐ nicht einverstanden

- dass unsere Tochter/unser Sohn _____ an der Studie teilnimmt und dass jede Gruppendiskussion, an der mein Kind beteiligt ist, aufgenommen (Audio), verschriftlicht, anonymisiert und ausschließlich für wissenschaftliche Zwecke verwendet wird.

☐ Ich bin bevollmächtigt, diese Einverständniserklärung im Namen beider Erziehungsberechtigten unseres Kindes abzugeben.

Ort, Datum

Unterschrift eines Erziehungsberechtigten

Bitte geben Sie diesen Zettel Ihrem Kind bis zum 11.02.2019 mit in die Schule!



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Homepage: www.neue-oberschule-groepelingen.de

Appendix B.3

Focus Group Consent Form for Teachers (NOG)



Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
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Einwilligungserklärung zur Erhebung und Verarbeitung personenbezogener Interviewdaten für Forschungszwecke

Forschungsprojekt: „Teaching Grit“ (Lernmotivation-Studie)

Durchführende Institution: Bremen International Graduate School of Social Sciences

Projektleitung: Cristina Greculescu, Affiliated Ph.D. Fellow

InterviewerInnen: Cristina Greculescu (Projektleitung), Stefanie Gahre (Studentische Hilfskraft)

Interviewdatum: 04.02.2019 und 25.02.2019

Art der personenbezogenen Daten der interviewten Person: Name, E-Mail Adresse

Beschreibung des Forschungsprojekts und seiner Ziele (zutreffendes bitte ankreuzen):

☒ mündliche Erläuterung

☐ schriftliche Erläuterung

Die Durchführung der **Gruppendiskussionen** im Rahmen des Projekts „Teaching Grit“ geschieht auf Grundlage der Bestimmungen des Datenschutzgesetzes und der Evaluationsordnung der Universität Bremen/Jacobs University Bremen. Alle MitarbeiterInnen im Projekt unterliegen der Schweigepflicht und sind auf das Datengeheimnis verpflichtet.

Die **Teilnahme an der Gruppendiskussion ist freiwillig**. Eine Nichtteilnahme hat keine Folgen. Sie haben zu jeder Zeit und ohne Angabe von Gründen die Möglichkeit, das Gespräch abzubrechen, weitere Interviews abzulehnen und Ihr **Einverständnis** in eine Aufzeichnung und Niederschrift des Gesagten **zurückzuziehen**, ohne dass Ihnen dadurch irgendwelche Nachteile entstehen. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Die Gruppendiskussion wird mit einem Aufnahmegerät aufgezeichnet (**Tonaufnahme**) und von den MitarbeiterInnen des Projekts in Schriftform gebracht. Für die weitere Auswertung der Transkripte werden alle Angaben, die zu einer Identifizierung der Person führen könnten, **anonymisiert** oder aus dem Text entfernt. Das verschriftlichte Gruppengespräch wird nicht veröffentlicht. Es darf jedoch, unter Beschränkung auf Ausschnitte, für den Ergebnisbericht und das Thesenpapier, zitiert werden.

Die Projektverantwortlichen tragen dafür Sorge, dass alle erhobenen Daten streng **vertraulich** behandelt und ausschließlich für wissenschaftliche Zwecke verwendet werden. Insofern dies nicht anders gesetzlich bestimmt ist oder Sie im Einzelfall ausdrücklich eingewilligt haben, erfolgt **keine Übermittlung von personenbezogenen Daten an Dritte**. Die Bandaufnahme wird von der Projektleitung verschlossen aufbewahrt und nach Abschluss der Untersuchung, spätestens jedoch **nach 10 Jahren, gelöscht**.

Sie können sich jederzeit an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

Hiermit willige ich ein, dass im Rahmen des Forschungsprojekts „Teaching Grit“ Daten meiner Person erhoben und ausgewertet werden. Die Erhebung erfolgt durch Audioaufnahmen, die in der Folge verschriftlicht, anonymisiert und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung auszugsweise verwendet werden.

Ort, Datum

Vorname, Nachname in Druckschrift

Unterschrift

Appendix B.4

Focus Group Consent Form for Students (NOG)



Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
Tel.: 017682030840
Email: cgreculescu@bigsss-bremen.de



Einwilligungserklärung zur Erhebung und Verarbeitung personenbezogener Interviewdaten für Forschungszwecke

Forschungsprojekt: „Teaching Grit“ (Lernmotivation-Studie)

Durchführende Institution: Bremen International Graduate School of Social Sciences

Projektleitung: Cristina Greculescu, Affiliated Ph.D. Fellow

InterviewerInnen: Cristina Greculescu (Projektleitung), Stefanie Gahre (Studentische Hilfskraft)

Interviewdatum: 11.02.2019 und 04.03.2019

Art der personenbezogenen Daten der interviewten Person: Name, E-Mail Adresse

Beschreibung des Forschungsprojekts und seiner Ziele (zutreffendes bitte ankreuzen):

- ☒ mündliche Erläuterung
☐ schriftliche Erläuterung

Die Durchführung der **Gruppendiskussionen** im Rahmen des Projekts „Teaching Grit“ geschieht auf Grundlage der Bestimmungen des Datenschutzgesetzes und der Evaluationsordnung der Universität Bremen/Jacobs University Bremen. Alle MitarbeiterInnen im Projekt unterliegen der Schweigepflicht und sind auf das Datengeheimnis verpflichtet.

Die **Teilnahme an der Gruppendiskussion ist freiwillig**. Eine Nichtteilnahme hat keine Folgen. Sie haben zu jeder Zeit und ohne Angabe von Gründen die Möglichkeit, das Gespräch abzubrechen, weitere Interviews abzulehnen und Ihr **Einverständnis** in eine Aufzeichnung und Niederschrift des Gesagten **zurückzuziehen**, ohne dass Ihnen dadurch irgendwelche Nachteile entstehen. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Die Gruppendiskussion wird mit einem Aufnahmegerät aufgezeichnet (**Tonaufnahme**) und von den MitarbeiterInnen des Projekts in Schriftform gebracht. Für die weitere Auswertung der Transkripte werden alle Angaben, die zu einer Identifizierung der Person führen könnten, **anonymisiert** oder aus dem Text entfernt. Das verschriftlichte Gruppengespräch wird nicht veröffentlicht. Es darf jedoch, unter Beschränkung auf Ausschnitte, für den Ergebnisbericht und das Thesenpapier, zitiert werden.

Die Projektverantwortlichen tragen dafür Sorge, dass alle erhobenen Daten streng **vertraulich** behandelt und ausschließlich für wissenschaftliche Zwecke verwendet werden. Insofern dies nicht anders gesetzlich bestimmt ist oder Sie im Einzelfall ausdrücklich eingewilligt haben, erfolgt **keine Übermittlung von personenbezogenen Daten an Dritte**. Die Bandaufnahme wird von der Projektleitung verschlossen aufbewahrt und nach Abschluss der Untersuchung, spätestens jedoch **nach 10 Jahren, gelöscht**.

Sie können sich jederzeit an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

Hiermit willige ich ein, dass im Rahmen des Forschungsprojekts „Teaching Grit“ Daten meiner Person erhoben und ausgewertet werden. Die Erhebung erfolgt durch Audioaufnahmen, die in der Folge verschriftlicht, anonymisiert und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung auszugsweise verwendet werden.

Ort, Datum

Vorname, Nachname in Druckschrift

Unterschrift

Appendix B.5

Pilot Test Consent Form for Parents / Legal Guardians (NOG) – German Version



Projektleitung: Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
Campus Ring 1, 28759 Bremen; Tel.: 017682030840
Email: cgreculescu@bigsss-bremen.de



Liebe Eltern! Liebe Erziehungsberechtigte!

Im Rahmen einer Studie habe ich mit Hilfe einiger LehrerInnen und SchülerInnen der Neue Oberschule Gröpelingen zwei computergestützten Kurse über Lernmotivation und Lernstrategien entwickelt. Als nächstes werden diese Inhalte mit SchülerInnen der Klassen 7 und 8 getestet. Dazu zählen die **Teilnahme an zwei Online-Kursen, das Ausfüllen eines Fragebogens und das Spielen eines Rechen-Spiels.**

Im Fragebogen fragen wir Ihr Kind unter anderem nach seiner Lernmotivation, seinen Gewohnheiten bei der Schularbeit, seinen Schulnoten und seinen Zielen hinsichtlich des Schulabschlusses. Wir fragen auch nach Deutschkenntnissen, denn es ist wichtig sicherzustellen, dass die Kursinhalte für alle SchülerInnen verständlich sind, auch für diejenigen, die noch nicht perfekt Deutsch sprechen.

Erfahrungsgemäß macht die Teilnahme an einer Studie den SchülerInnen Spaß. Außerdem finden die Kurse und zugehörigen Aktivitäten nur an einem Schultag (26.4.19) von 08:30-14:00 Uhr statt, so dass der Schulalltag Ihres Kindes durch die Untersuchung so wenig wie möglich gestört wird. Das Vorgehen wurde mit der Schulleitung abgesprochen und von der Senatorin für Kinder und Bildung genehmigt.

Die **Anonymität** der Kinder wird jederzeit sichergestellt. Bei der Auswertung der Fragebögen und im Untersuchungsbericht werden keine Angaben zu einzelnen SchülerInnen gemacht. Wir versichern Ihnen, dass die erhobenen Daten ohne Ihre ausdrückliche Einwilligung nicht an Dritte weitergegeben werden. Sie werden nach Abschluss des Forschungsprojektes zu Zwecken der wissenschaftlichen Qualitätssicherung gemäß den Bestimmungen der BIGSSS/Universität Bremen gespeichert und nach 10 Jahren vernichtet.

Selbstverständlich ist die Teilnahme Ihres Kindes an der Studie **freiwillig**. Eine Nichtteilnahme hat keine Nachteile für Ihr Kind. Sie dürfen die Einwilligung in die Verarbeitung personenbezogener Daten jederzeit ohne Angabe von Gründen **widerrufen**. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Mit Ihrem Einverständnis tragen Sie zum Gelingen der Studie und zu einer weiteren Verbesserung des Schulalltags bei. Bitte unterschreiben Sie daher die Einverständniserklärung und geben Sie den Zettel Ihrem Kind **bis zum 24.04.2019** mit in die Schule zurück. Eine Lehrerin bzw. ein Lehrer wird die Erklärung einsammeln und an mich weitergeben.

Sollten Sie zuvor noch weitere Fragen zu dieser Studie haben, so kontaktieren Sie mich gerne telefonisch oder über die oben stehende E-Mail Adresse. Falls Sie allgemeine Fragen zum Datenschutz haben, Sie können sich an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

Mit freundlichen Grüßen, Cristina Greculescu

----- (hier abtrennen) -----

Einverständniserklärung

Ich bin damit

☐ einverstanden

☐ nicht einverstanden

- dass unsere Tochter/unser Sohn _____ an der Studie teilnimmt und die damit erhobenen personenbezogenen Daten (Geschlecht, Alter, Angabe zur Schullaufbahn, Schulnoten, Angabe zu Deutschkenntnissen) im Rahmen der Untersuchung **anonym und ausschließlich für wissenschaftliche Zwecke** verarbeitet werden.
- und dass diese personalisierte Einverständniserklärung 10 Jahre in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt wird und anschließend vernichtet wird.

☐ Ich bin bevollmächtigt, diese Einverständniserklärung im Namen beider Erziehungsberechtigten unseres Kindes abzugeben.

Ort, Datum

Unterschrift eines Erziehungsberechtigten

Bitte geben Sie diesen Zettel Ihrem Kind bis zum 24.04.2019 mit in die Schule!



Lernen für die Zukunft in einer Gemeinschaft der Vielfalt

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Email: 444@bildung.bremen.de
Homepage: www.neue-oberschule-groepelingen.de

Appendix B.6

Pilot Test Consent Form for Parents / Legal Guardians (NOG) – Turkish Version



proje yönetimi: Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
Campus Ring 1, 28759 Bremen; Tel.: 017682030840
Email: cgreculescu@bigsss-bremen.de



Sayın Veliler,

bir kaç (Neue Oberschule Gröpelingen okulunda bulunan) öğretmen ve öğrencinin desteğiyle öğrenme motivasyonu ve öğrenme stratejileri hakkında bilgisayar temelli iki kurs geliştirmek istiyorum. Sonradan bu çalışmanın sonucunu 7. ve 8. sınıfta bulunan öğrencilerle test etmek istiyorum. Öğrencilerin bu test sırasında bir **online kursa** katılmaları, bu çalışmayla ilgili bir **soru kağıdı** doldurmaları ve bir **hesap oyunu** oynamaları gerekiyor.

Soru kağıdında çocuğunuza sorduğumuz soruların arasında öğrenme motivasyonu, okul ödevlerindeki alışkanlıkları, okul notları ve okul mezuniyetiyle ilgili hedefleri hakkında sorular soracağız. Ayrıca almanca bilgisi hakkında sorular sormamız gerekecek, ki uygulayacağımız kursun içeriklerinin tüm öğrenciler tarafından tamamen anlaşılır olmasından emin olmamız önemlidir. Bu henüz almancayi mükemmel konuşamayan öğrenciler için de geçerlidir.

Böyle bir çalışmaya katılmak bizim tecrübemize göre öğrenciler için bir değişiklik ve yeni tecrübe oluşturuyor. Öte yandan kurs ve bağlamli faaliyetler sadece bir okul gününde (28.04.19) 08:30 ve 14:00 saatler arasında uygulanacaktır. Çocuğunuz bu çalışmaya katılması yüzünden okul gündeminden geri kalır diye kaygılanmanıza hiç gerek yok. Bu çalışmayla ilgili bütün detaylar okul müdüründen onaylanmıştır.

Tabii ki çocukların **anonimliği** öncelikli olarak muamele görecektir. Bu çerçevede bir öğrenci hakkında toplanan bilgiler kesinlikle sizin ve çocuğunuzun resmi onayı olmadan başkalarına dağıtılmayacaktır. Çalışmanın sonucunda BIGSSS/Bremen üniversite kurallarına uyarak bilimsel kalite güvenliği sebeplerinden dolayı kayıt edilecek ve sonunda silinecektir.

Tabii ki çocuğunuzun bu çalışmaya katılımı yalnızca sizin ve onun isteğinin ve rızanızla gerçekleşir. Çalışmaya katılmamanın kimseye bir dezavantajı yoktur. Proje esnasında gerekli olan, çocuğunuzun şahı hakkındaki toplanan bilgileri her an için bir neden vermeden **iptal** edebilirsiniz. İptal edilene kadar verilen bilgiler proje için kullanılabilir.

Çocuğunuzun bu çalışmaya katılmasını onaylarsanız bu projenin başarılı olmasına katkınız olacaktır ve bundan öte okul gündeminin daha iyi şekillendirmeye de. Bu yüzden kağıdın alt kısmındaki muvafakatnameyi imzalayıp **24.04.2019 tarihine kadar** çocuğunuzla okula yollarsanız çok sevinirim. Çocuğunuzun öğretmeni muvafakatnameleri toplayıp bana iletacaktır.

Eğer bu araştırma hakkında cevaplanmamış sorularınız varsa alt kısımdaki telefon numarası veya mailadresinden bana ulaşabilirsiniz. Eger veri koruma hakkında genel sorularınız varsa, yetkili tetkik merciine (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax no. 0421/498-18495, mail adresi: office@datenschutz.bremen.de) yönelebilirsiniz.

Saygılarımla,
Cristina Greculescu

----- (buradan kesiniz) -----

Lernmotivation projesi için muvafakatname:

Oğlumuzun/Kızımızın Lernmotivation projesine katılmasını...

- ☐ kabul ediyorum
☐ kabul etmiyorum

Bu proje çerçevesinde çocuğumuzun kişisel verileri (cinsiyet, sınıf, okul kariyeri, yaşam koşulları, okul notları, almanca bilgisi) kayıt edilip proje esnasında **anonim** şekilde **bilimsel amaçlar** için kullanılabilir.

Ayrıca bu muvafakatname 10 yıl süresi boyunca diğer verilerden ayrı kilitli bir çekmecede BIGSSS tarafından saklanıp süre dolduğunda yok edilebilir.

- ☐ Bu muvafakatnameyi her iki veli adına geri vermeye yetkiliyim

yer, tarih

İmza (bir velinin imzası yeterli)

Lütfen bu muvafakatnameyi en geç 24.04.2019 tarihine kadar çocuğunuzla okula yollayın!



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Homepage: www.neue-oberschule-groepelingen.de

Appendix B.7

Pilot Test Digital Assent Form for Students (NOG)

Liebe Schülerin, lieber Schüler!

Danke, dass du dir die Zeit nimmst, an dieser Studie über Lernmotivation teilzunehmen. Als Teil der Studie wirst du an einem **Online-Kurs teilnehmen**, zwei **Fragebögen ausfüllen** und ein **Rechnen-Spiel spielen**.

Deine Teilnahme ist natürlich **freiwillig**. Eine Nichtteilnahme hat keine Folgen. Du wirst nirgendwo nach deinem Namen gefragt und alle Antworten, die du in diesem Fragebogen gibst, bleiben **geheim**. Du darfst jederzeit und ohne Angabe von Gründen die Teilnahme an dieser Studie beenden oder Fragen überspringen, die du nicht beantworten möchtest.

Alle erhobenen Daten werden **anonym** und **ausschließlich für wissenschaftliche Zwecke** verarbeitet. Durch die Abgabe des ausgefüllten Fragebogens bist du mit der Teilnahme an der Studie und mit der Erhebung deiner Daten **einverstanden**.

Du kannst jederzeit Fragen zu dieser Studie per Email an **Cristina Greculescu (cgreculescu@bigsss-bremen.de)** richten. Falls du allgemeine Fragen zum Datenschutz hast, du kannst dich an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

Die Antworten, die du gibst, sind sehr wichtig und wertvoll für dieses Projekt. Es gibt keine richtigen oder falschen Antworten auf die Fragen. Wir interessieren uns nur für deine ehrliche Meinung.

Lies dir bitte jede Frage sorgfältig durch und **beantworte alle Fragen ehrlich und vollständig**. Wenn du bei einer Frage nicht sicher bist, kreuze das an, was am besten passt. Du hast 40 Minuten Zeit, um diesen Fragebogen auszufüllen.

“Es ist uns wichtig, dass du die Fragen sorgfältig liest und ehrlich deine Meinung sagst. Es gibt keine falschen Antworten. Richtig ist das, was *du* denkst.”

Appendix B.8

School Consent Form (GSO)

Von SNR:

Name der Schule: **Gesamtschule Bremen-Ost**

Schulleiter: **Herr Hans-Martin Utz**

an

Cristina Greculescu

Affiliated Ph.D. Fellow, Bremen International Graduate School of Social Sciences (BIGSSS)

Campus Ring 1 (South Hall), 28759 Bremen

E-Mail: cgreculescu@bigsss-bremen.de

Tel: 017682030840

betrifft: **Das Forschungsprojekt mit dem Titel „Teaching Grit: Examining the Effects of a School-Based Intervention to Foster Grit“**

Kurzbeschreibung *(weitere Informationen zum Thema und zur Relevanz dieser Studie finden Sie in dem Infobrief, den Sie bereits erhalten haben)*

Im Rahmen einer Doktorarbeit in Psychologie an der Bremen International Graduate School of Social Sciences (BIGSSS) werden (idealerweise alle) SchülerInnen der Klassen 7 und 8 einen Fragebogen ausfüllen, ein Rechnen-Spiel spielen, und an 0 bis 2 Online-Kursen zu Lernmotivation und –Strategien (je nach Versuchsgruppe) teilnehmen. Einige Monate nach der Intervention werden bis zu 10 SchülerInnen zu einem 30-45-minütigen Interview eingeladen, das außerhalb der Unterrichtszeiten durchgeführt wird.

Die folgende **Unterstützung** wird von der Seite der Schule erwünscht: Computerräume oder (Test-) Räume mit PCs oder Tablets bereitstellen, die SchülerInnen für den Zweck der Intervention aus dem Unterricht entlassen und die (anonymisierten) Schulnoten der SchülerInnen zur Verfügung stellen. (Klassen)LehrerInnen werden gebeten, die SchülerInnen während der Intervention zu überwachen (eine Lehrerin bzw. ein Lehrer pro Raum). Eine Lehrerin bzw. ein Lehrer wird gebeten, die Einverständniserklärungen für die Eltern aller SchülerInnen, die an der Studie teilnehmen möchten, zu verteilen und wieder einzusammeln. Alle Einverständniserklärungen (von Eltern und SchülerInnen) werden dann in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt.

Diese Untersuchung wurde durch die Senatorin für Kinder und Bildung genehmigt. Die Projektverantwortlichen tragen dafür Sorge, dass alle erhobenen Daten streng vertraulich behandelt und ausschließlich für wissenschaftliche Zwecke verwendet werden. Insofern dies nicht anders gesetzlich bestimmt ist oder die Schulleitung im Einzelfall ausdrücklich eingewilligt hat, erfolgt keine Übermittlung von erhobenen Daten an Dritte.

Die SchülerInnen werden durch einen alphanumerischen Code identifiziert, der für die Forscher anonym bleibt, aber **von der Schule** mit den Namen der SchülerInnen verknüpft werden kann. So kann die Schule gebeten werden, bis zu 10 SchülerInnen zu einem Interview bezüglich ihrer Lerngewohnheiten einzuladen. Um die Anonymität der SchülerInnen zu gewährleisten, werden die Codes und die Namen der SchülerInnen **getrennt** voneinander gespeichert. Die Schule wird gebeten, die Namen und Codes getrennt voneinander, sicher, und für unbefugte Dritte unzugänglich bis zur Veröffentlichung der Studie aufzubewahren. Die Forscher werden nur die Codes speichern. Auf diese Weise ist sichergestellt, dass nur die Schule sowohl auf die Namen als auch auf die Codes zugreifen kann. Nach der Untersuchung werden nur anonymisierte Daten (Codes und Studienergebnisse) zu Zwecken der wissenschaftlichen Qualitätssicherung für 10 Jahre auf dem passwortgeschützten BIGSSS-Server gespeichert und danach datenschutzgerecht gelöscht.

Die Forschungsergebnisse werden in wissenschaftlich üblicher Form veröffentlicht. Durch die **vollständige Anonymisierung veröffentlichter Daten** wird gewährleistet, dass keine Rückschlüsse auf persönlichen Daten gezogen werden können.

Fragen zu dieser Studie können per E-Mail an cgreulescu@bigsss-bremen.de gerichtet werden. Allgemeine Fragen zum Datenschutz können an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) gerichtet werden.

Einverständniserklärung der Schulleitung

Die für die Durchführung verantwortliche Person hat uns schriftlich und umfassend über die beabsichtigte Untersuchung informiert.

Wir sind damit

☐ einverstanden

☐ nicht einverstanden

- dass die durch Fragebögen und Aufgaben in den Online-Kursen erhobenen Daten von SchülerInnen unter deren Einverständnis (und des der Erziehungsberechtigten)
 - anonymisiert gespeichert werden und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung verwendet werden.
- und dass diese personalisierte Einverständniserklärung 10 Jahre in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt wird und anschließend vernichtet wird.

Uns ist bekannt, dass wir die Einwilligung jederzeit ohne Angabe von Gründen widerrufen können und, dass eine Nichtteilnahme keinerlei Nachteile für unsere Schule mit sich bringt.

Ort, Datum

Unterschrift, Stempel der Schule

Appendix B.9

Digital Assent Form for Students (GSO)

Liebe Schülerin, lieber Schüler!

Danke, dass du dir die Zeit nimmst, an dieser Studie über Lernmotivation teilzunehmen. Als Teil der Studie wirst du einen **Fragebogen ausfüllen**, ein **Rechnen-Spiel spielen** und möglicherweise (je nach Jahrgang und Klasse) an einem oder zwei **Online-Kursen teilnehmen**. Einige Monate später könntest du möglicherweise zu einem kurzen Interview zu deinen Lernerfahrungen eingeladen werden, das außerhalb der Unterrichtszeiten stattfindet.

Im Fragebogen fragen wir dich unter anderem nach deiner Lernmotivation, deinen Gewohnheiten bei der Schularbeit, deinen Schulnoten und deiner Absicht bezüglich des Schulabschlusses. Du wirst nirgendwo nach deinem Namen gefragt und alle Antworten, die du in diesem Fragebogen gibst, bleiben **geheim**.

Im Rechnen-Spiel sollst du Zahlenpaare in einer Zahlentafel finden, die zusammen 1000 ergeben. Je nach deinen Entscheidungen und deiner Leistung im Spiel kannst du einen von zwei Weserpark-Gutscheinen gewinnen.

Deine Teilnahme ist natürlich **freiwillig**. Eine Nichtteilnahme hat keine Folgen. Du darfst jederzeit und ohne Angabe von Gründen die Teilnahme an dieser Studie beenden oder Fragen überspringen, die du nicht beantworten möchtest.

Alle Daten werden **anonym** erhoben und **ausschließlich für wissenschaftliche Zwecke** verarbeitet. Im Studienbericht oder in Veröffentlichungen werden keine Angaben zu einzelnen Schüler/innen gemacht. Die Daten werden nach Abschluss der Untersuchung zu Zwecken der wissenschaftlichen Qualitätssicherung sicher aufbewahrt und nach 10 Jahren gelöscht.

Du kannst jederzeit Fragen zu dieser Studie per Email an **Cristina Greculescu (cgreculescu@bigsss-bremen.de)** richten. Falls du allgemeine Fragen zum Datenschutz hast, du kannst dich an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

In dem du unten auf "Ich stimme zu" klickst, bestätigst du, dass:

- du mit der Teilnahme an der Studie und mit der Erhebung und Speicherung deiner Daten **einverstanden** bist
- du alle Fragen nach bestem Wissen und Gewissen beantwortest.

☐ **Ich stimme zu**

Wir danken dir vielmals für deine Teilnahme an dieser Studie!

Die Antworten, die du gibst, sind sehr wichtig und wertvoll für dieses Projekt. Es gibt keine richtigen oder falschen Antworten auf die Fragen. Wir interessieren uns nur für deine ehrliche Meinung.

Lies dir bitte jede Frage sorgfältig durch und **beantworte alle Fragen ehrlich und vollständig**. Wenn du bei einer Frage nicht sicher bist, kreuze das an, was am besten passt.

Appendix B.10

Consent Form for Parents / Legal Guardians (GSO)



Cristina Greculescu, M.A.
Bremen International Graduate School of Social Sciences
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Seite 1

Elterninformation

Liebe Eltern! Liebe Erziehungsberechtigte!

Im Rahmen einer Studie werden zwei computergestützten Kurse über **Lernmotivation und Lernstrategien** mit SchülerInnen der Klassen 7 und 8 getestet.

Dazu zählen das **Ausfüllen eines Fragebogens**, das **Spiele eines Rechnen-Spiels** und die **Teilnahme an bis zu zwei Online-Kursen** (je nach Testgruppe). Einige Monate später werden bis zu 10 SchülerInnen zu einem 30-45-minütigen **Interview** eingeladen, das außerhalb der Unterrichtszeiten durchgeführt wird.

Im Fragebogen fragen wir Ihr Kind unter anderem nach seiner Lernmotivation, seinen Gewohnheiten bei der Schularbeit, seinen Schulnoten und seinen Zielen hinsichtlich des Schulabschlusses. Wir fragen auch nach Deutschkenntnissen, denn es ist wichtig sicherzustellen, dass die Kursinhalte für alle SchülerInnen verständlich sind, auch für diejenigen, die noch nicht perfekt Deutsch sprechen. Im Rechnen-Spiel sollen die SchülerInnen Zahlenpaare in einer Zahlentafel finden, die zusammen 100 ergeben. In den Online-Kursen geht es um das Gehirn, um Intelligenz, um Erfolg, um Wohlbefinden und um die Zukunftspläne der SchülerInnen. Wir werden den SchülerInnen auch einige Sachen zeigen, die ihnen helfen, schlau zu lernen und Fortschritte in jedem Bereich zu machen. Wenn Ihr Kind für das Interview ausgewählt wird, werden wir Fragen zu seiner Lernmotivation und seinen Lerngewohnheiten stellen.

Erfahrungsgemäß macht die Teilnahme an einer Studie den SchülerInnen Spaß. Die Kurse und zugehörigen Aktivitäten finden im Mai / Juni 2019 und im Januar 2020 statt. **Insgesamt** dauert die Teilnahme an der Studie nur zwischen 2,5 und 5,5 Stunden (je nach Testgruppe), so dass der Schulalltag Ihres Kindes durch die Untersuchung so wenig wie möglich gestört wird. Die genauen Zeiten und Daten für jede Klasse sind auf der zweiten Seite dieses Dokuments angegeben. Das Vorgehen wurde mit der Schulleitung abgesprochen und von der Senatorin für Kinder und Bildung genehmigt.

Die SchülerInnen werden durch Codes identifiziert, die für uns **anonym** bleiben und nur von der Schule mit den Namen der SchülerInnen verknüpft werden können. Das Interview, falls Ihr Kind daran teilnimmt, wird aufgezeichnet (Tonaufnahme) und verschriftlicht. Die Tonaufnahme wird nach der Untersuchung zerstört und nur das anonyme Protokoll wird gespeichert. Bei der Auswertung der Daten und im Untersuchungsbericht werden **keine Angaben zu einzelnen SchülerInnen** gemacht. Wir versichern Ihnen, dass die erhobenen Daten ohne Ihre ausdrückliche Einwilligung nicht an Dritte weitergegeben werden. Sie werden nach Abschluss des Forschungsprojektes zu Zwecken der wissenschaftlichen Qualitätssicherung gemäß den Bestimmungen der BIGSSS/Universität Bremen gespeichert und nach 10 Jahren vernichtet.

Selbstverständlich ist die Teilnahme Ihres Kindes an der Studie **freiwillig**. Eine Nichtteilnahme hat keine Nachteile für Ihr Kind. Bis zur Veröffentlichung der Studie dürfen Sie die Einwilligung in die Verarbeitung personenbezogener Daten jederzeit ohne Angabe von Gründen **widerrufen**. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Mit Ihrem Einverständnis tragen Sie zum Gelingen der Studie und zu einer weiteren Verbesserung des Schulalltags bei. Bitte unterschreiben Sie daher die Einverständniserklärung und geben Sie den Zettel Ihrem Kind bis zum 03.07.2019 mit in die Schule zurück. Eine Lehrerin bzw. ein Lehrer wird die Erklärung einsammeln und an mich weitergeben.

Sollten Sie zuvor noch weitere Fragen zu dieser Studie haben, so kontaktieren Sie mich gerne telefonisch oder über die oben stehende E-Mail Adresse. Falls Sie allgemeine Fragen zum Datenschutz haben, Sie können sich an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.



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Einverständniserklärung

Ich bin damit

- ☐ einverstanden
☐ nicht einverstanden

- ☐ dass unsere Tochter/unser Sohn

_____ (Vorname, Nachname)

an der Studie teilnimmt und die damit erhobenen personenbezogenen Daten (Geschlecht, Alter, Angabe zur Schullaufbahn, Schulnoten, Angabe zu Deutschkenntnissen) im Rahmen der Untersuchung **anonym und ausschließlich für wissenschaftliche Zwecke** verarbeitet werden.

- ☐ dass mein Kind, falls es zu einem Interview eingeladen wird, Fragen zu seiner Lernmotivation und seinen Lerngewohnheiten beantwortet. Der Name meines Kindes wird während des Interviews an keiner Stelle abgefragt.

- ☐ und dass diese personalisierte Einverständniserklärung 10 Jahre in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt wird und anschließend vernichtet wird.

- ☐ Ich bin bevollmächtigt, diese Einverständniserklärung im Namen beider Erziehungsberechtigten unseres Kindes abzugeben.

Ort, Datum

Unterschrift eines Erziehungsberechtigten

Bitte geben Sie diesen Zettel Ihrem Kind bis zum 03.07.2019 mit in die Schule!

Appendix B.11

Focus Group Consent Form for Students (GSO)



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Einwilligungserklärung zur Erhebung und Verarbeitung personenbezogener Interviewdaten für Forschungszwecke

Forschungsprojekt: "Teaching Grit" (Lernmotivation-Studie)

Durchführende Institution: Bremen International Graduate School of Social Sciences (BIGSSS)

Interviewerin: Cristina Greculescu (Projektleitung), Affiliated Ph.D. Fellow, BIGSSS

Interviewdatum: 02.07.2020 / 03.07.2020

Art der personenbezogenen Daten der interviewten Person: persönliche Meinungen

Einreichung der Einwilligungserklärung: Die Einwilligungserklärung wird an Frau Greculescu zu Beginn des Interviews abgegeben.

Beschreibung des Forschungsprojekts und seiner Ziele (zutreffendes bitte ankreuzen):

- ☒ mündliche Erläuterung
☐ schriftliche Erläuterung

In diesem Interview stellen wir dir Fragen zu deinen Lernerfahrungen, deinen Lerngewohnheiten und dem Online-Kurs, an dem du im Mai 2019 teilgenommen hast.

Deine Teilnahme an das Interview ist natürlich **freiwillig**. Eine Nichtteilnahme hat keine Folgen. Du darfst jederzeit und ohne Angabe von Gründen das Gespräch abbrechen und dein **Einverständnis** in eine Aufzeichnung und Niederschrift des Gesagten **zurückziehen**, ohne dass dir dadurch irgendwelche Nachteile entstehen. Die bis zum Widerruf erhobenen Daten dürfen für das Projekt verwendet werden.

Das Interview wird mit einem Aufnahmegerät aufgezeichnet (**Tonaufnahme**) und anschließend in Schriftform gebracht. Alle Angaben, die zu deiner Identifizierung führen könnten, werden **anonymisiert** oder aus dem Text entfernt. Das verschriftlichte Gespräch wird nicht veröffentlicht. Ausschnitte dürfen jedoch für den Ergebnisbericht und das Thesenpapier zitiert werden.

Alle erhobenen Daten werden **vertraulich** behandelt und ausschließlich für wissenschaftliche Zwecke verwendet. Ohne deine ausdrückliche Zustimmung werden personenbezogenen Daten nicht an Dritte weitergegeben. Die Audioaufnahme wird nach der Durchführung der Untersuchung vernichtet. Das anonymisierte schriftliche Protokoll wird zu Zwecken der wissenschaftlichen Qualitätssicherung gespeichert und **nach 10 Jahren** gelöscht.

Du kannst jederzeit Fragen zu dieser Studie per E-Mail an Cristina Greculescu (cgreculescu@bigsss-bremen.de) richten. Falls du allgemeine Fragen zum Datenschutz hast, du kannst dich an die zuständige Aufsichtsbehörde für den Datenschutz (Die Landesbeauftragte für Datenschutz und Informationsfreiheit, Arndtstr. 1, 27570 Bremerhaven, Fax: 0421/496-18495, E-Mail: office@datenschutz.bremen.de) wenden.

Hiermit willige ich ein, dass im Rahmen des Forschungsprojekts „Teaching Grit“ Daten meiner Person erhoben und ausgewertet werden. Die Erhebung erfolgt durch Audioaufnahmen, die in der Folge verschriftlicht, anonymisiert und für wissenschaftliche Analysen und daraus hervorgehende Veröffentlichung auszugsweise verwendet werden. Außerdem stimme ich zu, dass diese personalisierte Einverständniserklärung 10 Jahre in einer verschlossenen Schublade bei der BIGSSS getrennt von den Erhebungsdaten aufbewahrt wird und anschließend vernichtet wird.

Vorname, Nachname in Druckschrift

Ort, Datum



Unterschrift

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Appendix C.1

Teacher Script for the Pilot Test (NOG)

„Heute testen wir mit euch ein Zahlensuchspiel und zwei Online-Kurse. Vielen Dank, dass ihr an dieser Studie teilnehmt.

Ihr seid die Ersten, mit denen wir diesen Inhalt teilen. Bitte habt etwas Geduld, wenn technische Probleme auftreten. Wir werden versuchen, sie zu lösen wenn es welche gibt.

Hoffentlich habt ihr alle heute eure Kopfhörer mitgebracht. Wenn nicht, haben wir ein paar hier. Wer braucht Kopfhörer?

Bevor wir anfangen, sollten wir schnell überprüfen, ob ihr alles habt, was ihr braucht:

- ein leeres Blatt Papier
- einen Zettel mit euren Anmeldeinformationen
- einen Zettel mit einem darauf gedruckten Satz
- und einen Stift.

Wenn ihr eins davon nicht habt, sagt es jetzt.

Das Wichtigste heute ist, dass wir **euer Feedback** zum Spiel und den beiden Online-Kursen bekommen. Am Ende des Spiels und am Ende jedes Kurses gibt es einen kurzen Fragebogen, in dem ihr nach eurer ehrlichen Meinung gefragt werdet. Bitte klickt an, was ihr von den Sachen haltet und ob alles verständlich war. Dieses Feedback wird uns dabei helfen, das Spiel und die Kurse für die Schüler eurer Schule und für andere Schüler in Bremen noch interessanter zu machen.

OK? Alles bereit?

Zuerst müsst ihr euch mit eurem regulären Log-In am PC / Laptop anmelden.

Alle fertig? OK.

Nun solltet ihr den Chrome-Browser (Hinweis für Lehrer: oder Internet Explorer, je nachdem welcher schneller war) starten und in die Adressleiste / Eingabeleiste oben diesen Link eingeben:

tiny.cc/t13q5y

(Hinweis für Lehrer: Den Link auf dem Blatt Papier anzeigen)

OK? Ihr gelangt auf eine Anmeldeseite. Sieht jeder die Login-Seite? OK.

Gebt nun den Benutzernamen und das Passwort ein, das auf eurem Zettel angegeben ist. Wenn ihr es richtig eingibt, solltet ihr euch anmelden können und einen Fragebogen sehen.

Beantwortet die Fragen **noch NICHT**. Wir sagen euch, wann ihr anfangen sollt.

Ihr seht dort eine Liste mit Fragen. Wenn ihr alle Fragen auf einer Seite beantwortet habt, müsst ihr unten rechts auf "Weiter" klicken, um zur nächsten Seite zu kommen.

Wenn ihr mit dem Fragebogen fertig seid, macht bitte **nicht** gleich das Zahlensuchspiel. Ihr sollt eine kurze Pause machen (10 Minuten) und wir machen dann zusammen weiter.

OK? Ihr benötigt keine Kopfhörer für den Fragebogen. Wenn etwas nicht funktioniert, hebt bitte

eine Hand und ich / einer von uns wird zu Euch kommen.

Ihr könnt jetzt die Fragen beantworten.“

------(Schüler füllen den Fragebogen aus, ca. 45 Min.)-----

------(Schüler machen 10 Minuten Pause)-----

„Willkommen zurück! Nun klickt auf die Schaltfläche, die Euch zum Zahlensuchspiel führt. Lest euch die Anweisungen für das Spiel sorgfältig durch. Verwendet immer die Taste „weiter“, um zur nächsten Seite zu gelangen. Ihr könnt das Spiel einmal üben, bevor ihr es tatsächlich spielt.

Wenn ihr mit dem Spiel fertig seid, klickt **NICHT** auf die Schaltfläche, mit der ihr zum ersten Kurs gelangt. Ihr sollt eine kurze Pause machen (5-10 Minuten).

OK? Ihr braucht keine Kopfhörer für das Spiel. Wenn etwas nicht funktioniert, hebt bitte eine Hand und ich / einer von uns wird zu Euch kommen.

Ihr könnt jetzt zum Spiel gehen.“

------(Schüler spielen das Mathe-Spiel (20-30 Min.)-----

------(Schüler machen 10 Minuten Pause)-----

"Willkommen zurück. Klickt nun auf die Schaltfläche, die euch zum ersten Online-Kurs führt. Über diese Schaltfläche gelangt ihr zu einer anderen Anmeldeseite. Bitte gebt hier die Anmeldedaten (Benutzername und Passwort) ein, die auf eurem Zettel stehen.

Sobald ihr angemeldet seid, wird der erste Kurs geladen. Zum Vergrößern des Videos, klickt auf die Pfeile in der unteren rechten Ecke des Videofensters. Seid ihr jetzt im Vollbildmodus? Prima!

Wenn ihr den ersten Kurs beendet habt, fahrt **nicht** gleich mit dem zweiten Kurs fort. Ihr sollt zuerst eine Pause machen.

Jetzt müsst ihr eure Kopfhörer aufsetzen.

Drückt jetzt auf die große Wiedergabetaste (Play) in der Mitte des Bildschirms.“

------(Schüler schauen sich den ersten Kurs an)-----

„Ist jeder mit diesem Teil fertig? Jetzt sollt ihr eine Pause von 15 bis 20 Minuten machen.“

------(Schüler machen 15-20 Min. Pause)-----

"Willkommen zurück. Nun klickt auf die Schaltfläche, um zum zweiten Kurs zu kommen. Dieser Kurs ist in zwei Hälften aufgeteilt. Zuerst macht ihr die erste Hälfte des Kurses, dann macht ihr eine Pause, dann macht ihr die andere Hälfte.

Also, wenn ihr mit der ersten Hälfte fertig seid, fahrt **nicht** gleich mit dem nächsten Teil weiter. Zuerst macht ihr eine Pause und dann macht ihr weiter.

In der ersten Hälfte habt ihr zwei Aufgaben, die euch zu externen Seiten führen. Wenn ihr dann zum Video zurückkehrt, müsst ihr auf die kleine Wiedergabetaste (Play) unten links drücken, um mit dem Video fortzufahren.

Wenn etwas nicht zu funktioniert, hebt eine Hand und ich / einer von uns wird zu euch kommen.

Drückt nun auf die Schaltfläche mit dem Titel: „Hier klicken, um den zweiten Kurs aufzurufen.“

Die erste Hälfte des Kurses wird jetzt geladen. Bitte vergrößert das Video (Vollbildmodus).

Jetzt müsst ihr eure Kopfhörer aufsetzen.

Drückt jetzt auf die große Wiedergabetaste (Play) in der Mitte des Bildschirms.“

----- (Schüler schauen sich die erste Hälfte des zweiten Kurses an) -----

„Ist jeder mit diesem Teil fertig? Jetzt sollt ihr eine Pause von 15 bis 20 Minuten machen.“

----- (Schüler machen 15-20 Min. Pause) -----

„Willkommen zurück. Nun könnt ihr auf die Schaltfläche drücken, auf der steht: Klicke hier, um den dritten Teil aufzurufen.

Der Kurs wird jetzt geladen. Bitte vergrößert das Video (Vollbildmodus).

Jetzt müsst ihr eure Kopfhörer aufsetzen.

Drückt jetzt auf die große Wiedergabetaste (Play) in der Mitte des Bildschirms.“

----- (Schüler schauen sich die zweite Hälfte des zweiten Kurses an) -----

„Großartig! Nun sind wir fertig. Vielen Dank für eure Zeit!“

Appendix C.2

Teacher Script for the Main Study (GSO, AM Condition)

Projektleitung: Cristina Greculescu, Bremen International Graduate School of Social Sciences
Campus Ring 1, 28759 Bremen; E-Mail: cgreculescu@bigsss-bremen.de; Tel: 017682030840

Informationen für Lehrer/innen

Sehr geehrte Lehrer/innen,

Herr Engel-Krepplein hat Ihnen diese Studie bereits erwähnt. Vielen Dank, dass Sie sich bereit erklärt haben, die Schüler/innen während der Intervention zu beaufsichtigen.

Unten finden Sie den Text, den Sie während der Intervention verwenden sollten. **Bitte stellen Sie sicher, dass die Schüler/innen nicht miteinander sprechen und während der Intervention keine anderen Internetseiten öffnen.**

Abhängig von der Versuchsgruppe werden die Schüler entweder

- a) nur einen Fragebogen ausfüllen und ein Rechen-Spiel spielen (Kontrollgruppe, Klassen 7.4, 8.2, 8.3),
- b) den Fragebogen ausfüllen, das Rechen-Spiel spielen und an dem ersten Onlinekurs teilnehmen (Gruppe A, Klassen 7.1, 8.1, 8.5),
- c) den Fragebogen ausfüllen, das Rechen-Spiel spielen und am dem zweiten Onlinekurs teilnehmen (Gruppe B, Klassen 7.3, 7.6, 8.4) oder
- d) den Fragebogen ausfüllen, das Rechen-Spiel spielen und an beiden Online-Kursen teilnehmen (Gruppe AB, Klassen 7.2, 7.5, 8.6).

Wenn Sie Fragen zu den verschiedenen Teilen der Intervention haben, lassen Sie es mich wissen.

Text für Gruppe A (7.1, 8.1, 8.5)

22.05.2019, 8-11 Uhr

„Heute nehmt ihr an einer Studie über **Lernmotivation und Erfolg in der Schule und im Leben** teil. Vielen Dank, dass ihr an der Untersuchung teilnehmt.

Ihr seid die Ersten, mit denen wir diesen Inhalt teilen. Bitte habt etwas Geduld, wenn technische Probleme auftreten. Wir werden versuchen sie zu lösen, wenn es welche gibt.

Bevor wir anfangen, sollten wir schnell überprüfen, ob ihr alles habt, was ihr braucht:

- Kopfhörer
- und einen Stift.

Wenn ihr eins davon nicht habt, sagt es **jetzt**.

Ich werde jetzt ein Blatt Papier verteilen, das ihr **später** für eine Aufgabe im Online-Kurs braucht. *(Hinweis für Lehrer/innen: Bitte verteilen Sie das Arbeitsblatt für den Brief)* OK? Alles bereit?

Zuerst müsst ihr euch mit eurem regulären Log-in am PC / Tablet anmelden. Alle fertig? OK.

Nun solltet ihr den Chrome-Browser starten und in die Adressleiste oben diesen Link eingeben: **tiny.cc/t13q5y** *(Hinweis für Lehrer/innen: Den Link auf dem Blatt Papier anzeigen)*

OK? Sieht jeder die Login-Seite?

Nun müsst ihr euren eigenen Benutzernamen erstellen. Das Format ist:

- Initialen des Vornamens und des Familiennamens
- Jahrgang
- Klasse
- Geburtsdatum (Tag + Monat)

Beispiel: Für Erika Mustermann, aus der Klasse 8.3, geboren am 12. Oktober, der Benutzername wäre EM831210.

(Hinweis für Lehrer/innen: Sie werden auch ausgedruckte Zettel mit den Namen und Benutzernamen der Schüler/innen bereit haben, falls es einigen Schüler/innen nicht gelingt, eigene Benutzernamen zu erstellen.)

Nachdem ihr euren Benutzernamen eingegeben habt, gebt bitte das Passwort **GSO19** ein. Wenn ihr alles richtig angegeben habt, solltet ihr euch anmelden können und einen Fragebogen sehen.

Beantwortet die Fragen **noch nicht**. Wir sagen euch, wann ihr anfangen sollt.

Ihr seht dort eine Liste mit Fragen. Wenn ihr alle Fragen auf einer Seite beantwortet habt, müsst ihr unten rechts auf „Weiter“ klicken, um zur nächsten Seite zu kommen.

Wenn ihr mit dem Fragebogen fertig seid, klickt auf die Schaltfläche, die euch zu einem Zahlensuchspiel führt. Lest euch die Anweisungen für das Spiel sorgfältig durch. Verwendet immer die Taste „weiter“, um zur nächsten Seite zu kommen. Ihr könnt das Spiel einmal üben, bevor ihr es tatsächlich spielt.

Wenn ihr auch mit dem Spiel fertig seid, klickt bitte **nicht** auf die Schaltfläche, die euch zu dem Online-Kurs führt. **Wir machen davor eine Pause.**

Ihr braucht keine Kopfhörer für den Fragebogen aber ihr braucht Kopfhörer für das Zahlensuchspiel. **Vergesst also nicht, eure Kopfhörer aufzusetzen, bevor ihr mit dem Spiel anfängt.**

Ihr sollt nicht miteinander sprechen und keine anderen Internetseiten auf euren PCs / Tablets öffnen! Wenn etwas nicht funktioniert, hebt bitte eine Hand und ich / einer von uns wird zu euch kommen. Ihr könnt jetzt die Fragen beantworten“.

(Schüler füllen den Fragebogen aus, ca. 30-40 Min.)

(Schüler spielen das Spiel, ca. 20-30 Min.)

„Ist jeder mit dem Spiel fertig? Großartig! Jetzt macht ihr eine 15-20 Minuten Pause und wir treffen uns hier um Uhr.“

(Schüler machen eine 15-20 Minuten Pause)

„Willkommen zurück. Klickt nun auf die Schaltfläche, die euch zu dem Online-Kurs führt.

Wenn etwas nicht funktioniert, hebt bitte eine Hand und ich / einer von uns wird zu euch kommen.

Zum vergrößern des Videos, klickt auf die Pfeile in der unteren rechten Ecke des Videofensters. Seid ihr jetzt im Vollbildmodus? Prima! Ihr müsst jetzt eure Kopfhörer aufsetzen. Drückt jetzt auf die große Wiedergabetaste (Play) in der Mitte des Bildschirms.“

(Schüler schauen sich den ersten Kurs an, ca. 1 Stunde)

„Ist jeder mit dem Kurs fertig? Großartig! Nun sind wir für heute fertig. Ende Juni werden wir uns erneut treffen, um das Zahlensuchspiel noch einmal zu spielen, allerdings nur für eine Runde. Bitte bringt noch einmal euren Kopfhörer mit.“

Wenn ihr das Spiel bis dahin zu Hause üben möchtet, könnt ihr jetzt einen Link bei mir abholen, wo ihr Beispielübungen findet. Ihr müsst euch mit euren Benutzernamen und Passworte anmelden, um das Spiel zu üben. Bewahrt bitte also eure Anmeldedaten gut auf.

Und ihr könnt auch eure **Abzeichen-Kärtchen** bei mir abholen, die ihr mit nach Hause nehmen sollt.

Die Briefe, die ihr geschrieben habt, bleiben aber bei mir.

Danke, dass ihr heute mitgemacht habt.“

Ende Juni (vorläufiges Datum für Gruppe A: 24.06.2019)

„Heute spielt ihr das Zahlensuchspiel noch einmal. Habt ihr zu Hause geübt?

Hoffentlich habt ihr alle heute eure Kopfhörer mitgebracht. Wenn nicht, haben wir ein Paar hier. Wer braucht Kopfhörer?

Zuerst müsst ihr euch mit eurem regulären Log-in am PC / Tablet anmelden. Alle fertig? OK.

Nun solltet ihr den Chrome-Browser starten und in die Adressleiste oben diesen Link eingeben: **tiny.cc/t13q5y** (Hinweis für Lehrer/innen: Den Link auf dem Blatt Papier anzeigen)

OK? Sieht jeder die Login-Seite? OK.

Nun müsst ihr euren eigenen Benutzernamen eingeben. erinnert ihr euch noch an das Format? Es ist:

- Initialen des Vornamens und des Familiennamens
- Jahrgang
- Klasse
- Geburtsdatum (Tag + Monat)

Beispiel: Für Erika Mustermann, aus der Klasse 8.3, geboren am 12. Oktober, der Benutzername ist EM831210.

(Hinweis für Lehrer/innen: Sie werden auch ausgedruckte Zettel mit den Namen und Benutzernamen der Schüler/innen bereit haben, falls es einigen Schüler/innen nicht gelingt, eigene Benutzernamen zu erstellen.)

Nachdem ihr euren Benutzernamen eingegeben habt, gebt bitte das Passwort **GSO19** ein. Wenn ihr alles richtig angegeben habt, solltet ihr euch anmelden können und die Spielanleitung sehen.

Sehen alle die Spielanleitung? Großartig! Ihr müsst jetzt eure Kopfhörer aufsetzen. Lest euch die Anweisungen für das Spiel sorgfältig durch. Verwendet immer die Taste „weiter“, um zur nächsten Seite zu kommen.“

Ihr sollt nicht miteinander sprechen und keine anderen Internetseiten auf euren PCs / Tablets öffnen! Wenn etwas nicht funktioniert, hebt bitte eine Hand und ich / einer von uns wird zu euch kommen. Ihr könnt jetzt die Fragen beantworten“.

(Schüler spielen das Spiel, ca. 10 Min.)

„Ist jeder mit dem Spiel fertig? Großartig! Nun habt ihr an allen Teilen dieser Studie teilgenommen. Nochmals vielen Dank!“

Appendix D.1

Focus Group Interview Guide (NOG Teachers, AM Course)

- 1 Kurze Vorstellungsrunde
- 2 Grundregeln festlegen
- 3 Kurze Vorstellung des gesamten Projektes
- 4 Thema: (Lern-)Denkweisen
 - wachstumsorientierte Haltung (aus dem Engl. ‘Growth Mindset’)
 - “Meine Fähigkeit und Kompetenz wachsen, wenn ich mich anstrengende“
 - Sinnhaftigkeit **oder** Selbstwertbestätigung
 - “Diese Arbeit entspricht meinen Interessen, Werten oder Zielen“
 - soziale Zugehörigkeit
 - “Ich gehöre in diese (Schul)Gemeinschaft“
- 5 Eröffnungsstatements von Teilnehmern
 - 5.1 Inhaltsaspekte (Texte, Videos, Schreibaufgaben)
 - 5.2 Sprachaspekte
 - 5.3 Logischer Ablauf
 - 5.4 Kursdauer und Aufteilung des Inhalts in zwei Teile
- 6 Fragebögen
 - 6.1 Sprachaspekte
- 7 Mathe-Spiel
 - 7.1 Konzept der Aufgabe
 - 7.2 Schwierigkeitsgrad
 - 7.3 Angemessene Belohnungen
- 8 Abschlusserklärungen der Teilnehmer

Wachstumsorientierte Haltung

- Teil 1: Das formbare Gehirn
 - Brainstorming: was braucht man, um Erfolg in der Schule zu haben?
 - Schüler*innen lernen, dass sich das Gehirn durch Lernen verändern kann (Neuroplastizität, Text & Animation)
 - „Das Gehirn kann wie ein Muskel wachsen“ (z.B. kurzes Video & Text)
- Teil 2: Persönliche Erfolgsgeschichten
 - Lehrkraft/Prominente*r berichtet über persönlichen Lernerfolg, der durch Anstrengung und harte Arbeit entstanden ist (z.B. kurzes Video oder Text)
 - Schüler*innen sollen über eigene Erfahrungen und Beispielgeschichten nachdenken und evtl. kurz über sie berichten
- Teil 3: *Saying-is-Believing*
 - Schüler*innen verfassen einen kurzen Brief an eine/n Schüler*in, der/die Schwierigkeiten in der Schule hat und motivieren ihn/sie anhand ihrer neuen Erkenntnisse

Sinnhaftigkeit

- Teil 1: Wie kann die Welt ein besserer Ort werden?
 - Schüler*innen schreiben ein paar Sätze darüber, wie die Welt ein besserer Ort werden könnte.
- Teil 2: Strukturierte Lese- und Schreibaufgabe:
 - Umfragestatistiken zeigen, dass die meisten Schüler motiviert sind, in der Schule gute Leistungen zu erbringen, teilweise "um eine Karriere zu haben, die ihnen

Spaß macht" oder auch "um einen Beitrag für eine bessere Welt zu leisten". Diese Statistiken werden von repräsentativen Zitaten begleitet (angeblich von Oberstufenschülern an der eigenen Schule), die die zentrale Botschaft unterstützen.

- Die Schüler teilen zukünftigen Schülern ihre Gründe zu lernen in zwei bis vier Sätzen mit. Sie erklären, wie das Lernen in der Schule ihnen helfen kann, die Person zu werden, die sie sein möchten, oder die Menschen in ihrer Umgebung / die Gesellschaft im Allgemeinen positiv zu beeinflussen.

oder Selbstwertbestätigung

- Teil 1: Werte wählen
 - Die Schüler ordnen Werte aus einer Liste von Werten ein und / oder wählen den für sie persönlich wichtigsten Wert aus der Liste aus.
 - Mögliche Werte: gut im Sport sein; gut in Kunst oder Literatur sein; gut aussehen, attraktiv sein; selbstständig sein; Mitglied einer Gruppe (z. B. deines Stadtteils/deiner Nachbarschaft, Kultur oder Schulverein) sein; Musik; Politik; Beziehungen zu Freunden oder der Familie (oder „mit Freunden und Familie zusammen sein“); Religion oder Glaube; Sinn für Humor; Kreativität, Dinge entdecken, um die Welt zu verändern; Freundlichkeit und Großzügigkeit (oder „freundlich und großzügig sein“); im Augenblick leben; eigene moralische Prinzipien; Natur und Umwelt; eine erfolgreiche Karriere
- Teil 2: Schreibaufgabe. Die Schüler denken über Zeiten nach, in denen dieser bestimmte Wert für sie sehr wichtig war (oder über Situationen, in denen dieser Wert für sie sehr wichtig sein könnte) und beschreiben in wenigen Sätzen, warum dieser Wert für sie wichtig ist.
- Teil 3: Kurze Umfrage. Die Schüler nennen die zwei wichtigsten Gründe, warum dieser Wert für sie wichtig ist. Die Schüler geben an, inwieweit sie den nachfolgenden Aussagen zustimmen oder nicht zustimmen. 1. Dieser Wert hat mein Leben beeinflusst. 2. Dieser Wert ist ein wichtiger Teil von mir. 3. „Im Allgemeinen versuche ich, diesen Wert zu erreichen.“

Soziale Zugehörigkeit

- Teil 1: Umfrageergebnisse. Die Schüler lesen die Ergebnisse einer „aktuellen Schülerumfrage“, die angeblich mit älteren Schülern ihrer Schule und ähnlichen Schulen durchgeführt wurde. Die Umfrageergebnisse vermitteln zwei Hauptideen: (1) Die meisten Schüler machen sich Sorgen, ob sie dazugehören. Dies gilt unabhängig von der ethnischen Herkunft, ihrem Geschlecht, oder anderen Merkmalen. (2) Und dass diese Sorgen mit der Zeit nachlassen, wenn die Schüler aktive Schritte unternehmen, um Beziehungen zu anderen Personen in ihrer Schule aufzubauen.
- Teil 2: Erfolgsgeschichten. Die Schüler lesen Kurzgeschichten von Schülern aus höheren Klassen, in denen sie ihre Erfahrungen beschreiben - die Herausforderungen, mit denen sie konfrontiert waren und wie sie sie überwunden haben, um dazu zu gehören und erfolgreich zu sein.
- Teil 3: Die Schüler werden zunächst gebeten, anhand ihrer Erfahrungen (z. B. Wechsel von der Grundschule zur Sekundarschule), einige Sätze darüber zu schreiben, warum es normal ist, sich anfangs zu fragen, inwieweit man zur Schulgemeinschaft dazugehört. Als nächstes schreiben sie ein paar Sätze darüber, wie und warum diese anfänglichen Sorgen bezüglich ihrer Zugehörigkeit mit der Zeit nachlassen, sobald sich die Schüler in ihrer Schule zu Hause fühlen. Den Schülern wird mitgeteilt, dass ihre Aufsätze zukünftigen Schülern anonym zur Verfügung gestellt werden könnten, um diesen in ähnlichen Situationen zu helfen.

Appendix D.2

Focus Group Interview Guide (Students, post-intervention)

1. Einführung

In diesem Gruppengespräch stelle ich euch Fragen zum Lernen und zu den Online-Kursen, an denen ihr letztes Jahr teilgenommen habt.

Ich werde das Gespräch mit meinem Smartphone aufzeichnen, dann werde ich zu Hause alles aufschreiben, was ihr gesagt habt, und danach werde ich die Tonaufnahmen löschen. Ich werde keine Namen aufschreiben oder mir notieren, wer was gesagt hat. Für die Studie ist es wichtig, von jedem von euch so viel ehrliches Feedback wie möglich zu bekommen. Ihr könnt eure Gedanken also frei teilen.

Die Regeln des Gesprächs sind wirklich einfach. Ich werde ein paar Dinge erklären und ein paar Fragen stellen. Wenn einer von euch spricht, sollten die anderen zuhören. Spricht also bitte nicht im Hintergrund miteinander, sonst kann ich nichts von den Audioaufnahmen verstehen.

Habt ihr bisher Fragen?

2. Aufwärmabschnitt

OK, beginnen wir mit einigen allgemeinen Fragen:

- Gefällt euch die Schule? Lernt ihr gerne? Wenn ja, warum? Wenn nicht, warum nicht? Jeder von euch sollte bitte ein paar Worte dazu sagen.
- Lass uns nun etwas genauer darauf eingehen. Sagt mir, wie lernt ihr zu Hause? Arbeitet ihr allein oder mit einem Freund oder einer Lerngruppe? Wie oft lernt ihr zu Hause? Wann und wo lernt ihr am liebsten?
- Habt ihr Hausaufgaben oder Pflichtlektüre für zu Hause? Oder macht ihr das alles in der Schule nach dem Unterricht? Ok, denkt jetzt an Schulaufgaben, die ihr zu Hause machen solltet. Macht ihr diese Aufgaben? Erklärt warum ja oder warum nicht. Welche Schulaufgaben macht ihr gerne zu Hause und welche nicht?
- Wie viel Zeit verbringt ihr jeden Tag / jede Woche damit, für die Schule zu lernen? Und wie viel Zeit verbringt ihr mit anderen Aktivitäten, z. B. Hobbys, Sport, Fernsehen, Videospielen, Lesen usw.? Wofür verbringt ihr die meiste Zeit?
- Es ist schon einige Zeit vergangen, seit ich euch kennengelernt habe und ihr an den Online-Kursen teilgenommen habt. Wie war der Übergang zur nächsten Klasse für euch (also von der X. zur X. Klasse)? Wie gut (oder schlecht) wart ihr in der Schule im ersten Halbjahr der X. Klasse (also bis Januar 2020, bevor COVID-19 eintraf)?

3. Hauptabschnitt

- Aus dem Bauch heraus, an was erinnert ihr euch noch aus dem Online-Kurs (oder den Online-Kursen), an dem / an denen ihr im Mai letzten Jahres teilgenommen habt? Sagt einfach alles, was euch gerade so einfällt.

- Erinnern ihr euch spontan an irgendwelche Tipps und Tricks aus dem Kurs (oder den Kursen), die ihr später eingesetzt habt, um besser zu lernen?

Jetzt werde ich euch schnell an die Hauptideen des Kurses (oder der Kurse) erinnern, damit wir näher darauf eingehen können.

- Was hat euch an dem Online-Kurs gefallen (oder nicht gefallen)? Welche Teile oder Aufgaben fandet ihr besonders interessant?
- Haben die Postkarten mit den Abzeichen, die ihr verdient habt, euch an den Kurs erinnert?
- Was habt ihr eigentlich in eurem eigenen Leben angewendet, nachdem ihr an dem Kurs teilgenommen habt?
 - Was hat euch geholfen?
 - Was hat nicht geholfen und warum?
- Glaubt ihr, irgendetwas, was ihr im Kurs gelernt habt, hat euch verändert? Wenn ja, wie hat es euch verändert?

(Bewertungsfragen)

- Würdet ihr solche Kurse anderen Schülern empfehlen? Bitte erklärt warum oder warum nicht.
- Wie können die Kurse für zukünftige Teilnehmer verbessert werden (im Sinne von Struktur, Inhalt, Länge usw.)?

4. Schließabschnitt

Ok, mal sehen, ob ich euch richtig verstanden habe und ob ich euer Feedback zusammenfassen kann.

- Habt ihr noch etwas, das ihr erwähnen möchtet, was die Schule, das Lernen generell oder die Online-Kurse angeht?

Danke für euer Feedback. Dieses Gruppengespräch hat mir (und der Studie) sehr geholfen!

Appendix E.1

Student Questionnaire (T1 / T2)

Selbstberichtetes Grit-Niveau (Allgemein) / Grit (general)	
1.	Ich setze mir oft ein Ziel, entscheide mich dann aber später doch ein anderes Ziel zu verfolgen.
2.	Neue Ideen und Projekte halten mich manchmal von vorherigen ab.
3.	Ich war schon einmal für eine kurze Zeit von einem Projekt oder einer Idee so richtig begeistert, habe später aber das Interesse verloren.
4.	Ich habe Schwierigkeiten bei Projekten voll dabei zu bleiben, wenn diese mehrere Monate dauern.
5.	Alles was ich beginne, bringe ich auch zu Ende.
6.	Von Rückschlägen (Niederlagen) lasse ich mir nicht den Mut nehmen.
7.	Ich bin ein hart arbeitender Mensch.
8.	Ich bin fleißig.

Answer scale **Grit (general)**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Selbstberichtetes Grit-Niveau (Schulspezifisch) / Grit (school-specific)	
1.	In der Schule nehme ich mir oft etwas vor, verliere mein Ziel dann aber aus den Augen.
2.	Manchmal gibt es neue Ideen und Vorhaben, die mich davon abhalten, meine schulischen Ziele zu erreichen.
3.	Ich war in der Schule schon mal für eine kurze Zeit von einem Vorhaben oder einem Projekt so richtig begeistert, habe später aber das Interesse verloren.
4.	Wenn schulische Vorhaben oder Projekte länger als einige Wochen dauern, habe ich Schwierigkeiten mich immer richtig darauf zu konzentrieren.
5.	Was ich mir in der Schule vorgenommen habe, mache ich auch zu Ende.
6.	Von Rückschlägen (Niederlagen) in der Schule lasse ich mir nicht den Mut nehmen.
7.	Ich arbeite hart für die Schule.
8.	Ich bin ein fleißiger Schüler/ eine fleißige Schülerin.

Answer scale **Grit (school-specific)**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Selbstkontrolle in der Schule / School self-control	
1.	Ich komme vorbereitet in den Unterricht.
2.	Im Unterricht passe ich auf und lasse mich nicht ablenken.
3.	Ich folge Anweisungen und erinnere mich an sie.
4.	Ich fange gleich mit der Arbeit an, anstatt sie aufzuschieben.

Answer scale **School self-control**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Schulbezogene Selbstwirksamkeitserwartung / School self-efficacy
1. Ich kann auch die schwierigen Aufgaben im Unterricht lösen, wenn ich mich anstrengende.
2. Es fällt mir leicht, neuen Unterrichtsstoff zu verstehen.
3. Wenn ich eine schwierige Aufgabe an der Tafel lösen soll, glaube ich, dass ich das schaffen werde.
4. Auch wenn ich mal längere Zeit krank sein sollte, kann ich sicher immer noch gut in der Schule sein.
5. Wenn der Lehrer / die Lehrerin den Unterrichtsstoff noch schneller durchzieht, schaffe ich die geforderten Leistungen kaum noch.
6. Auch wenn der Lehrer / die Lehrerin an meinen Fähigkeiten zweifelt, bin ich mir sicher, dass ich gute Leistungen bringen kann.
7. Ich bin mir sicher, dass ich auch dann noch meine gewünschten Leistungen erreichen kann, wenn ich mal eine schlechte Note bekommen habe.

Answer scale **School self-efficacy**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Gewissenhaftigkeit-A / Conscientiousness
1. Ich bin eigentlich eher faul.
2. Ich erledige Aufgaben gründlich.

Answer scale **Conscientiousness**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Implicit Theories of Intelligence Scale / Mindset
1. Ich bin so intelligent, wie ich bin; das kann ich nicht verändern.
2. Meine Intelligenz ist etwas, das ich kaum verändern kann.
3. Ich kann zwar neue Dinge lernen, aber meine Intelligenz kann ich dadurch nicht wirklich verändern.

Answer scale **Mindset**

- 1 stimmt gar nicht
- 2 stimmt wenig

- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Schulengagement / Behavioural school engagement
1. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich meine Hausaufgaben nie gemacht. Im letzten Monat, habe ich meine Hausaufgaben selten gemacht. Im letzten Monat, habe ich meine Hausaufgaben manchmal gemacht. Im letzten Monat, habe ich meine Hausaufgaben oft gemacht. Im letzten Monat, habe ich meine Hausaufgaben immer gemacht.
2. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich im Unterricht nie aufgepasst. Im letzten Monat, habe ich im Unterricht selten aufgepasst. Im letzten Monat, habe ich im Unterricht manchmal aufgepasst. Im letzten Monat, habe ich im Unterricht oft aufgepasst. Im letzten Monat, habe ich im Unterricht immer aufgepasst.
3. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich nie meine Hefte oder Papier in der Schule dabei gehabt. Im letzten Monat, habe ich selten meine Hefte oder Papier in der Schule dabei gehabt. Im letzten Monat, habe ich manchmal meine Hefte oder Papier in der Schule dabei gehabt. Im letzten Monat, habe ich oft meine Hefte oder Papier in der Schule dabei gehabt. Im letzten Monat, habe ich immer meine Hefte oder Papier in der Schule dabei gehabt.
4. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich Unterricht nie geschwänzt. Im letzten Monat, habe ich Unterricht selten geschwänzt. Im letzten Monat, habe ich Unterricht manchmal geschwänzt. Im letzten Monat, habe ich Unterricht oft geschwänzt. Im letzten Monat, habe ich Unterricht immer geschwänzt.
5. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich an Diskussionen im Unterricht nie aktiv teilgenommen. Im letzten Monat, habe ich an Diskussionen im Unterricht selten aktiv teilgenommen. Im letzten Monat, habe ich an Diskussionen im Unterricht manchmal aktiv teilgenommen. Im letzten Monat, habe ich an Diskussionen im Unterricht oft aktiv teilgenommen. Im letzten Monat, habe ich an Diskussionen im Unterricht immer aktiv teilgenommen.
6. Wähle den Satz aus, der am besten zu dir passt:
Im letzten Monat, habe ich nie hart gearbeitet, um in der Schule gut zu sein. Im letzten Monat, habe ich selten hart gearbeitet, um in der Schule gut zu sein. Im letzten Monat, habe ich manchmal hart gearbeitet, um in der Schule gut zu sein. Im letzten Monat, habe ich oft hart gearbeitet, um in der Schule gut zu sein. Im letzten Monat, habe ich immer hart gearbeitet, um in der Schule gut zu sein.

Interesse an Mathematik / Interest in Mathematics
Wie interessant ist deiner Meinung nach das Fach Mathematik?
Answer scale Interest in Math 1 überhaupt nicht interessant 2 wenig interessant

- 3 einigermaßen interessant
- 4 sehr interessant
- 5 höchst interessant

Rechenangst / Fear of Mathematics

Wie sehr macht dich das Fach Mathematik in der Schule nervös, besorgt oder voller Angst?

Answer scale **Fear of Math**

- 1 überhaupt nicht
- 2 wenig
- 3 mittelmäßig
- 4 viel
- 5 extrem

Skala zur Schulzugehörigkeit / School belongingness

1. Ich fühle mich in meiner Schule zuhause.

2. Die Leute in meiner Schule akzeptieren mich.

3. Ich fühle mich in meiner Schule als Außenseiter.

Answer scale **School belongingness**

- 1 stimmt gar nicht
- 2 stimmt wenig
- 3 teils teils
- 4 stimmt ziemlich
- 5 stimmt völlig

Geschlecht und Alter / Gender and Age

Was ist dein Geschlecht?

Wie alt bist du? Jahre

Sprachkenntnisse / German proficiency

1. Wie gut kannst du Deutsch lesen?

2. Wie gut kannst du Deutsch schreiben?

3. Bei dir zu Hause, wie oft wird Deutsch gesprochen?

Answer scale **German proficiency 1 and German proficiency 2**

- 1 Schlecht
- 2 Ein bisschen
- 3 Mittelmäßig
- 4 Gut
- 5 Sehr gut

Answer scale **German proficiency 3**

- 1 nie
- 2 selten
- 3 manchmal
- 4 oft

5 Immer

Bücher / Books at home (images of book shelves are used for this set of questions)
1. Wie viele Bücher hast du ? Bitte zähle hier keine E-Books (elektronische Bücher) oder Schulbücher.
2. Und wie viele Bücher gibt es bei dir zu Hause insgesamt?

Answer scale **Books at home 1 (with images of bookshelves!)**

- 1 Keine
- 2 Eins bis fünf
- 3 Sechs bis zehn
- 4 Elf bis zwanzig
- 5 Mehr als zwanzig

Answer scale **Books at home 2 (with images of bookshelves!)**

- 1 Keine
- 2 Eins bis zwanzig
- 3 Einundzwanzig bis fünfzig
- 4 Einundfünfzig bis einhundert
- 5 Mehr als einhundert

Angestrebter Schul-, Berufs- und Ausbildungsabschluss / Desired school-leaving certificate; desired professional qualification
Welchen Schulabschluss strebst du an?
Welchen Ausbildungs-/Berufsabschluss strebst du an?

Answer scale **Desired school-leaving certificate**

- 1 Berufsbildungsreife (BBR)
- 2 Erweiterte Berufsbildungsreife (eBBR)
- 3 Mittlerer Schulabschluss (MSA)
- 4 Abitur/Hochschulreife
- 5 einen anderen, und zwar

Answer scale **Desired training / professional qualification**

Erstbefragung (first survey, T1)

- 1 Betriebliche Ausbildung (z.B. Tischler/in, Konditor/in)
Schulische Ausbildung (z.B. Gesundheits- und Krankenpfleger/in,
- 2 Erzieher/in)
- 3 Studienabschluss (z.B. Bachelor, Master)
- 4 einen anderen, und zwar

Answer scale **Desired training / professional qualification**

Zweitbefragung (second survey, T2)

- 1 Betriebliche Ausbildung (duale Ausbildung in Betrieb und Berufsschule)
Schulische Ausbildung (vollschulische Ausbildung an einer Berufsfachschule
- 2 oder Fachakademie)
- 3 Studienabschluss (z.B. Bachelor, Master)
- 4 einen anderen, und zwar

Selbst gewählte Ziele (Erstbefragung) / Self-selected goals (first survey, T1)
Was ist für dich bis zum Ende dieses Jahres ein wichtiges Ziel in der Schule? Bitte

versuche so genau wie möglich zu sein.

Was ist für dich bis zum Ende dieses Jahres ein wichtiges persönliches Ziel? (ein Ziel, das **nicht** mit der Schule zu tun hat). Bitte versuche so genau wie möglich zu sein.

Selbst gewählte Ziele (Zweitbefragung) / Self-selected goals (second survey, T2)

Letztes Jahr hast du angegeben, dass das folgende Ziel **ein wichtiges Ziel in der Schule** für dich war:

Bitte beantworte die folgenden Fragen zu diesem bestimmten Ziel:

1. Dieses Ziel ist mir immer noch wichtig.

2. Wie viel hast du bisher getan, um dieses Ziel zu erreichen?

3. Inwieweit hast du dieses Ziel bereits erreicht?

4. Falls du derzeit immer noch Mühe und Zeit in dieses Ziel steckst, glaubst du, dass du es noch erreichen kannst?

Letztes Jahr hast du auch angegeben, dass das folgende Ziel **ein wichtiges persönliches Ziel** für dich war:

Bitte beantworte die folgenden Fragen zu diesem bestimmten Ziel:

1. Dieses Ziel ist mir immer noch wichtig.

2. Wie viel hast du bisher getan, um dieses Ziel zu erreichen?

3. Inwieweit hast du dieses Ziel bereits erreicht?

4. Falls du derzeit immer noch Mühe und Zeit in dieses Ziel steckst, glaubst du, dass du es noch erreichen kannst?

Answer scale **School goal achievement 1, Personal goal achievement 1**

1 stimmt gar nicht

2 stimmt wenig

3 teils teils

4 stimmt ziemlich

5 stimmt völlig

Answer scale **School goal achievement 2, Personal goal achievement 2**

1 sehr viel

2 viel

3 weder viel noch wenig

4 wenig

5 gar nichts

Answer scale **School goal achievement 3, Personal goal achievement 3**

1 völlig erreicht

2 größtenteils erreicht

3 teilweise erreicht

4 kaum erreicht

5 überhaupt nicht erreicht

Answer scale **School goal achievement 4, Personal goal achievement 4**

1 Ich bin fest davon überzeugt, dass ich es noch erreichen kann.

2 Ich bin ziemlich davon überzeugt, dass ich es noch erreichen kann.

3 Ich bin einigermaßen davon überzeugt, dass ich es noch erreichen kann.

4 Ich bin kaum davon überzeugt, dass ich es noch erreichen kann.

5 Ich bin überhaupt nicht davon überzeugt, dass ich es noch erreichen kann.

6 Ich habe dieses Ziel bereits erreicht.

Appendix E.2

Sample Math Game Instructions and Grids

Jetzt beginnen wir unser Hauptspiel mit 5 Runden. Wir haben zwei verschiedene Arten von Spielen. Eines ist das **5-er** Spiel. Wenn du hier erfolgreich bist, kannst du 5 Zettel mit deinem Namen in die Lostrommel für die Gutscheine werfen. Wenn du es nicht schaffst, darfst du deinen Namen nur einmal in die Lostrommel werfen.

👤 = 5; 🗳️ = 1

Wir haben auch ein **3-er** Spiel. Wenn du hier erfolgreich bist, kannst du 3 Zettel mit deinem Namen in die Lostrommel für die Gutscheine werfen. Wenn du es nicht schaffst, darfst du deinen Namen nur einmal in die Lostrommel werfen.

👤 = 3; 🗳️ = 1

Das Ziel ist in beiden Spielen dasselbe: innerhalb von 90 Sekunden (1,5 Minuten) **mindestens 3 Paare** zu finden, die zusammen 1000 ergeben. Falls du keine 3 Paare finden kannst, bist du nicht erfolgreich.

Was ist also der Unterschied zwischen den Spielen?

5-er Spiel

109	513	505	510	547
323	456	351	772	222
891	888	911	344	810
766	453	108	649	655
290	123	228	439	111

3-er Spiel

109	465
610	228
535	850
320	891
772	150

Beide Raster haben **die gleiche Anzahl von Zahlenpaaren**, aber im 5-er Spiel sind sie schwieriger zu finden, da das Raster größer ist. In jeder Runde spielst du entweder das 5-er oder das 3-er Spiel.

Appendix F.1

Descriptive Statistics for RQ 3b Variables by Treatment Group (RM-ANCOVA)

Conscientiousness

Descriptive Statistics				
	Treatment	Mean	Std. Deviation	N
Conscientiousness A (2 items, T1) - Centered - Version 2	Academic Mindsets	-,0734	,97437	39
	Academic Mindsets + Learning Skills & Strategies	-,0445	,77528	48
	Learning Skills & Strategies	,1350	,90099	55
	Control Group (no intervention)	,0205	,80585	50
	Total	,0180	,85996	192
Conscientiousness A (2 items, T2) - Centered - Version 2	Academic Mindsets	,0611	1,05628	39
	Academic Mindsets + Learning Skills & Strategies	-,0334	,72169	48
	Learning Skills & Strategies	,1124	,87665	55
	Control Group (no intervention)	-,0976	,90964	50
	Total	,0108	,88699	192

School belonging

Descriptive Statistics				
	Treatment	Mean	Std. Deviation	N
School belonging (2 items, T1) - Centered - Version 2	Academic Mindsets	,1530	,77690	39
	Academic Mindsets + Learning Skills & Strategies	-,1219	,79050	48
	Learning Skills & Strategies	,0853	,84577	54
	Control Group (no intervention)	-,0373	,85809	50
	Total	,0150	,82188	191
School belonging (2 items, T2) - Centered - Version 2	Academic Mindsets	,0280	,90935	39
	Academic Mindsets + Learning Skills & Strategies	-,2236	,98908	48
	Learning Skills & Strategies	,0843	,77461	54
	Control Group (no intervention)	,0372	,87037	50
	Total	-,0169	,88601	191

School self-control

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
BART factor score for School Self-Control (T1) - Version 2	Academic Mindsets	,0232546	1,30778636	39
	Academic Mindsets + Learning Skills & Strategies	-,0090897	,88592231	47
	Learning Skills & Strategies	,2060394	1,24529229	55
	Control Group (no intervention)	-,0649711	1,01934532	51
	Total	,0442623	1,11859100	192
BART factor score for School Self-Control (T2) - MAIN	Academic Mindsets	,2684566	1,04425332	39
	Academic Mindsets + Learning Skills & Strategies	-,1603228	,99670639	47
	Learning Skills & Strategies	,0924489	1,07829350	55
	Control Group (no intervention)	-,1718517	1,29228822	51
	Total	-,0038808	1,11958861	192

School self-efficacy

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
BART factor score for short version of SSE (5 items, T1) - Version 3	Academic Mindsets	-,0744556	1,28838245	39
	Academic Mindsets + Learning Skills & Strategies	-,0604782	,92941721	48
	Learning Skills & Strategies	,2960019	1,10054331	55
	Control Group (no intervention)	-,0740770	1,08418377	50
	Total	,0352580	1,10193763	192
BART factor score for short version of SSE (5 items, T2) - MAIN - Version 3	Academic Mindsets	-,1329574	1,10029333	39
	Academic Mindsets + Learning Skills & Strategies	,0429043	,90093394	48
	Learning Skills & Strategies	,1260966	1,16548255	55
	Control Group (no intervention)	-,0898517	1,21349072	50
	Total	-,0035584	1,10143510	192

Theories of intelligence / Mindset

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
BART factor score for Theories of Intelligence (T1)	Academic Mindsets	,0560634	1,07350658	38
	Academic Mindsets + Learning Skills & Strategies	-,2809954	,84975275	47
	Learning Skills & Strategies	,1829940	1,16535151	54
	Control Group (no intervention)	,0072247	1,08010435	50
	Total	-,0044099	1,05848588	189
BART factor score for Theories of Intelligence (T2) - MAIN - Version 2	Academic Mindsets	,2023487	1,04819342	38
	Academic Mindsets + Learning Skills & Strategies	-,3347079	,93431344	47
	Learning Skills & Strategies	,1560187	1,10743759	54
	Control Group (no intervention)	,0001976	1,03769379	50
	Total	,0020787	1,04857113	189

Appendix F.2

Research Question 3c – Descriptive Statistics for School Engagement (RM-ANCOVA)

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
CFA factor score for School Engagement (T1)	Academic Mindsets	-,0251	,38076	39
	Academic Mindsets + Learning Skills & Strategies	-,0940	,38590	48
	Learning Skills & Strategies	,1162	,41682	54
	Control Group (no intervention)	,0065	,42564	50
	Total	,0058	,40890	191
CFA factor score for School Engagement (T2) - MAIN	Academic Mindsets	,0368	,51076	39
	Academic Mindsets + Learning Skills & Strategies	-,1549	,42245	48
	Learning Skills & Strategies	,1265	,45616	54
	Control Group (no intervention)	-,0276	,54573	50
	Total	-,0029	,49219	191

Appendix F.3

Research Question 3d – School goal achievement (MANOVA)

Descriptive Statistics				
	Treatment	Mean	Std. Deviation	N
Centered_Schoolgoalachievement1	Academic Mindsets	,1444	,65465	36
	Academic Mindsets + Learning Skills & Strategies	,0990	1,02196	44
	Learning Skills & Strategies	,0934	1,04206	49
	Control Group (no intervention)	-,2492	1,08816	47
	Total	,0138	,98849	176
Centered_Schoolgoalachievement2_Rev	Academic Mindsets	-,1186	1,10805	36
	Academic Mindsets + Learning Skills & Strategies	,0581	,76492	44
	Learning Skills & Strategies	,0679	,97895	49
	Control Group (no intervention)	-,0507	,99257	47
	Total	-,0044	,95752	176
Centered_Schoolgoalachievement3_Rev	Academic Mindsets	-,1238	,88864	36
	Academic Mindsets + Learning Skills & Strategies	-,1794	,75097	44
	Learning Skills & Strategies	,3665	,73540	49
	Control Group (no intervention)	-,1102	,93498	47
	Total	,0024	,85250	176
Centered_Schoolgoalachievement4_Rev	Academic Mindsets	,0339	1,04198	36
	Academic Mindsets + Learning Skills & Strategies	-,0494	,86603	44
	Learning Skills & Strategies	,0271	1,19701	49
	Control Group (no intervention)	-,0016	1,04080	47
	Total	,0017	1,03934	176

Appendix F.4

Research Question 3d – Personal goal achievement (MANOVA)

Descriptive Statistics				
	Treatment	Mean	Std. Deviation	N
Centered_Personalgoalachievement1	Academic Mindsets	-,0846	1,18257	26
	Academic Mindsets + Learning Skills & Strategies	-,1231	1,49461	26
	Learning Skills & Strategies	,1263	1,19729	29
	Control Group (no intervention)	,0079	1,07873	37
	Total	-,0123	1,21902	118
Centered_Personalgoalachievement2_Rev	Academic Mindsets	,0156	1,12044	26
	Academic Mindsets + Learning Skills & Strategies	-,1767	1,23101	26
	Learning Skills & Strategies	-,0029	1,03748	29
	Control Group (no intervention)	,1154	,70498	37
	Total	,0000	1,00686	118
Centered_Personalgoalachievement3_Rev	Academic Mindsets	-,2764	1,20256	26
	Academic Mindsets + Learning Skills & Strategies	-,3149	1,09334	26
	Learning Skills & Strategies	,4424	,77205	29
	Control Group (no intervention)	,0687	,73214	37
	Total	,0000	,98032	118
Centered_Personalgoalachievement4_Rev	Academic Mindsets	,0231	,97033	26
	Academic Mindsets + Learning Skills & Strategies	-,3231	1,37057	26
	Learning Skills & Strategies	,1637	1,57176	29
	Control Group (no intervention)	,1208	,89627	37
	Total	,0120	1,21465	118

Appendix F.5

Research Question 5 – Descriptive Statistics for Student GPA (RM-ANCOVA with Cluster)

Descriptive Statistics					
	Treatment	mclust	Mean	Std. Deviation	N
Copy of ADJ_AS_Z_ZGPA_Tend_T1	Academic Mindsets	1	-,2716	,74949	19
		2	,2036	,81464	15
		Total	-,0619	,80332	34
	Academic Mindsets + Learning Skills & Strategies	1	-,4145	,93004	27
		2	,1765	,76915	20
		Total	-,1630	,90581	47
	Learning Skills & Strategies	1	-,0663	,85378	29
		2	,4217	,87970	29
		Total	,1777	,89376	58
	Control Group (no intervention)	1	-,2893	,73738	29
		2	,4569	,46801	18
		Total	-,0035	,73916	47
	Total	1	-,2564	,82435	104
		2	,3297	,76310	82
		Total	,0020	,84761	186
Copy of ADJ_AS_Z_ZGPA_Tend_T2	Academic Mindsets	1	-,3745	,77230	19
		2	,1901	,79898	15
		Total	-,1254	,82289	34
	Academic Mindsets + Learning Skills & Strategies	1	-,2217	,86286	27
		2	,2177	,78080	20
		Total	-,0347	,84903	47
	Learning Skills & Strategies	1	,0352	,87129	29
		2	,4356	,88410	29
		Total	,2354	,89312	58
	Control Group (no intervention)	1	-,2572	,70998	29
		2	,5603	,51490	18
		Total	,0559	,75242	47
	Total	1	-,1879	,81096	104
		2	,3649	,77489	82
		Total	,0558	,83952	186

Appendix F.6

Descriptive Statistics and Correlations for Time 2 Variables and for Students' GPA (T3)

Descriptive Statistics and Correlations for Time 2 Variables

Variable	M ^a	SD	1	2	3	4	5	6	7	8	9	10	11
1. Perseverance (gen.)	.00	0.93	–										
2. Consistency (gen.)	.02	0.77	.010	–									
3. Grit (school)	.00	0.82	.484**	.411**	–								
4. Perseverance (school)	.00	1.53	.565**	.281**	.931**	–							
5. Consistency (school)	.00	1.45	.326**	.487**	.923**	.718**	–						
6. Conscientiousness	.00	0.87	.504**	.355**	.640**	.667**	.516**	–					
7. School belonging	.00	0.88	.138	.027	.187**	.141	.208**	.004	–				
8. School self-control	.00	1.09	.504**	.232**	.630**	.620**	.545**	.548**	.132	–			
9. School self-efficacy	.01	1.10	.465**	.171*	.464**	.475**	.383**	.342**	.207**	.553**	–		
10. School engagement	.00	0.47	.474**	.112	.609**	.610**	.517**	.468**	.220**	.506**	.297**	–	
11. Mindset	.00	1.05	-.002	-.152*	-.094	-.052	-.124	.030	-.142	.028	-.040	.017	–

Note. $n = 189$; Bootstrapping was used for correlation coefficients to ensure robustness. Bootstrap results are based on 1000 bootstrap samples.

^a All means are (close to) zero due to mean centering (for two-item scales) or dimension reductions via EFA/CFA (for scales with ≥ 3 items).

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Descriptive Statistics and Correlations for Students' GPA (Time 2/3)

	<i>n</i>	<i>M</i>	<i>SD</i>	PE (gen.)	CI (gen.)	Grit (school)	PE (school)	CI (school)	Big-5-C	ScBel	SSC	SSE	ToI	ScEng
GPA	182	.01	0.83	.364**	.115	.524**	.478**	.497**	.212**	.158*	.426**	.373**	-.100	.524**

Note. Bootstrapping was used for correlation coefficients to ensure robustness. Bootstrap results are based on 1000 bootstrap samples.

Gen. = domain-general; PE = Perseverance of effort; CI = Consistency of interests; Big-5-C = Conscientiousness; ScBel = School Belonging; SSC = School self-control; SSE = School self-efficacy; ToI = Mindset; ScEng = School engagement.

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix G.1

Complete Coding Frame (Qualitative Strand)

- Einstellungen zur Schule und zum Schulsystem (Eb. 1)
 - Unzufriedenheit mit der Schule (Eb. 2)
 - Schule als anstrengend / stressig (Eb. 3)
 - Freude an der Schule (Eb. 2)
 - Instrumentelles/zukunftsorientiertes Schulbild (Eb. 2)
 - Schule als wichtiger Sozialisationsort (Eb. 2)
 - Schwächen des Schulsystems (Eb. 2)
 - Irrelevante Fächer (Eb. 3)
 - Langweiliger Unterricht (Eb. 3)
 - Konstruktive Kritik am Schulsystem (Eb. 2)
- Lern- und Hausaufgabengewohnheiten und –einstellungen (Eb. 1)
 - Hausaufgabenstrategien (Eb. 2)
 - HA (teilweise) in der Schule erledigen (Eb. 3)
 - HA gemeinsam mit Freunden erledigen (Eb. 3)
 - (Zu)neigung – Hausaufgaben (Eb. 2)
 - Abneigung gegen Hausaufgaben (Eb. 3)
 - Freude an Hausaufgaben (Eb. 3)
 - Selektive Freude an Hausaufgaben (Eb. 3)
 - Hausaufgabenerledigung (Eb. 2)
 - Konsistente HA-Erledigung (Eb. 3)
 - Inkonsistente HA-Erledigung (Eb. 3)
 - Hausaufgaben als wichtig für Noten und Verständnis (Eb. 2)
 - Grundeinstellungen zum Lernen (Eb. 2)
 - Erfolg bei minimalem Aufwand (Eb. 3)
 - Lernen als Notwendigkeit (Eb. 3)
 - Inhärenter Wert des Lernens (Eb. 3)
 - Lernneigung (Eb. 2)
 - Freude am Lernen (Eb. 3)
 - Lernunlust (Eb. 4)
 - Lernspaß (Eb. 4)
 - Pauklernansatz (Eb. 3)
 - Fach-/themenabhängiges Lernen (Eb. 3)
 - Stimmungs-/motivationsabhängiges Lernen (Eb. 3)
 - Notenorientiertes Lernen (Eb. 3)
 - Lernhäufigkeit (Eb. 2)
 - Geringe Lernhäufigkeit (Eb. 3)
 - Hohe Lernhäufigkeit (Eb. 3)
- Faktoren, die den Schulfortschritt beeinflussen (Eb. 1)
 - Akademische Fortschritte (Eb. 2)
 - Erhöhter Aufwand und Engagement der Schule (Eb. 3)
 - Unterstützendes Umfeld (Eb. 3)
 - Lehrerwechsel (Eb. 4)
 - Einfachere Themen (Eb. 3)
 - Akademische Rückschläge (Eb. 2)

- Geringerer Aufwand (Eb. 3)
- Erhöhter akademischer Druck und Anforderungen (Eb. 3)
- Nicht unterstützendes Umfeld (Eb. 3)
 - Lehrerwechsel (Eb. 4)
- Akademischer Stillstand (Eb. 2)
- Spontane Erinnerungen an die Grit-Kurse (Eb. 1)
 - Spezifische Kursinhalte (Eb. 2)
 - Videos (Eb. 3)
 - Schüleraussagen (Eb. 3)
 - Lernen / Konzentrationstipps (Eb. 3)
 - Thema: Zielsetzung (Eb. 3)
 - Thema: Zukunft (Eb. 3)
 - Thema: Besser in der Schule werden (Eb. 3)
 - Thema: Gehirn / Neuroplastizität (Eb. 3)
 - Postkarten mit Abzeichen (Eb. 2)
 - Fragebogen (Eb. 2)
 - Selbst gewählte Ziele (Eb. 3)
 - Mathespiel (Eb. 2)
- Überlegungen zur Anwendung und Wirkung von Grit-Kursen (Eb. 1)
 - Postkarten als Erinnerungshilfe (Eb. 2)
 - Verloren / weggeworfen (Eb. 3)
 - Hilfreich (Eb. 3)
 - Wirkungsvoller oder interessanter Inhalt (Eb. 2)
 - Gedanken zur Zukunft (AM / LSS) (Eb. 3)
 - Infos zum Gehirn und Neuroplastizität (AM) (Eb. 3)
 - Erfolg durch Anstrengung – Video (AM) (Eb. 3)
 - Du kannst alles lernen - Video (AM) (Eb. 3)
 - WOOP-Methode (LSS) (Eb. 3)
 - Klare, positiv formulierte Ziele (LSS) (Eb. 3)
 - Bewusstes Üben (LSS) (Eb. 3)
 - Erfolgreich werden (AM / LSS) (Eb. 3)
 - Selbst gewählte Ziele (Fragebogen) (Eb. 3)
 - Fehlen nennenswerter Effekte (Eb. 2)
- Evaluiertes Feedback zum Grit-Kursdesign (Eb. 1)
 - Positives Feedback (Eb. 2)
 - Die Kurse sind empfehlenswert (Eb. 3)
 - Negatives Feedback (Eb. 2)
 - Verbesserungsvorschläge (Eb. 2)
 - Verbesserungsideen (AM) (Eb. 3)
 - Verbesserungsideen (LSS) (Eb. 3)
 - Integration der Grit-Inhalte in den Lehrplan (Eb. 3)
 - Idealer Zeitpunkt für die Kurse (Eb. 3)
 - Organisatorisches Feedback (Eb. 3)
- Persönliche Gedanken zum Lernen, Leben und zukünftigen Zielen (Eb. 1)

Appendix G.2

Coding Example for One Question in One Focus Group

GRADE 8 (+)

Moderatorin: #00:02:09-8# Gefällt euch die Schule? Lernt ihr gerne? Wenn ja, warum? Wenn nicht, warum nicht?

Teilnehmer/in 1: #00:02:17-0# Also ich finde ja, die Schule gefällt mir, weil ich brauche das für mein späteres Leben sozusagen. Und damit ich genau weiß, also ich lerne viel und sozusagen, wie soll ich's sagen? Ich brauche es z. B. später. Zum Beispiel, wenn ich irgendwas mit... Wenn ich Deutschlehrerin werden will, dann brauche ich auch hier z. B. ... im Deutschunterricht lernen wir auch viel, und dann braucht man das ja sozusagen. Und ob ich gerne lerne? Ich glaube eher nicht. Ich glaube, keiner von uns lernt gerne! Aber man muss ja auch ... Also nicht alles muss einem gefallen, um es zu tun.

Teilnehmer/in 1: #00:02:54-8# Sondern manchmal muss man es tun.

Moderatorin: #00:03:03-2# Darf ich dich fragen? Was wäre wichtig für dich, dass du das Lernen besser magst oder dass du das immer gerne machst? Kann die Schule irgendwas dafür machen oder?

Teilnehmer/in 1: #00:03:33-9# Ich glaube weniger Hausaufgaben, sondern eher einfach nur arbeiten. Schreiben wäre besser.

Moderatorin: #00:03:39-3# Also die Hausaufgaben sind nicht gut. [Teilnehmer/in 2: Ja].
Moderatorin: Und dann würdest du das irgendwie besser finden nur Arbeiten zu schreiben? [Teilnehmer/in 2: Ja].

Teilnehmer/in 2: #00:04:01-0# Also, ich mag die Schule hier. Und auf jeden Fall... es ist so, wie [Teilnehmer/in 1] das gesagt hat. Also wichtig, weil man braucht halt den Abschluss, um eine Ausbildung oder so was zu machen. Also kommt halt immer drauf an was man halt für die Arbeit oder so braucht. Zum Beispiel wenn man Architektin werden will, braucht man, muss man halt sehr gut in Mathe sein.

Moderatorin: #00:04:25-1# Okay. Lernst du gerne?

Teilnehmer/in 2: #00:04:27-1# Nicht so, aber. Aber alle sind halt gezogen dazu zu lernen, weil es halt dann wichtig ist.

Moderatorin: #00:04:35-5# Okay. Hast du ein Lieblingsfach oder so?

Teilnehmer/in 2: Ja. Mathe. (...)

Moderatorin: Mathe! Das hört man nicht so oft. (...) Okay.

Teilnehmer/in 3: #00:04:53-1# Ich mag auch die Schule hier. Also, die haben eigentlich schon gesagt, warum man Schule mag! Ähm, beim Lernen liegt es halt an den Fächern. Es gibt Fächern, wo man gerne lernt und dann gibt es auch welche, wo man am liebsten gar nicht lernen möchte. Es liegt halt immer am Fach!

Moderatorin: #00:05:13-4# Okay. Und welche findest du am besten von dem Fächer?

Teilnehmer/in 3: Mathe?

Moderatorin: Auch Mathe, okay.

-  **Microsoft-Konto**
Freunde an der Schule (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Instrumentelles/zukunftsorientiertes Schulbild (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Lernlust (Eb. 4; Übergeordnete Kategorien: Freude am Lernen (Eb. 3), Lernneigung (Eb. 2), Lern- und Hausaufgabengewohnheiten und -einstellungen (Eb. 1))
-  **Microsoft-Konto**
Lernen als Notwendigkeit (Eb. 3; Grundeinstellung zum Lernen (Eb. 2), Lern- und Hausaufgabengewohnheiten und -einstellungen (Eb. 1))
-  **Microsoft-Konto**
Konstruktive Kritik am Schulsystem (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Freunde an der Schule (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Instrumentelles/zukunftsorientiertes Schulbild (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Lernlust (Eb. 4; Übergeordnete Kategorien: Freude am Lernen (Eb. 3), Lernneigung (Eb. 2), Lern- und Hausaufgabengewohnheiten und -einstellungen (Eb. 1))
-  **Microsoft-Konto**
Lernen als Notwendigkeit (Eb. 3; Grundeinstellung zum Lernen (Eb. 2), Lern- und Hausaufgabengewohnheiten und -einstellungen (Eb. 1))
-  **Microsoft-Konto**
Freunde an der Schule (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem)
-  **Microsoft-Konto**
Instrumentelles/zukunftsorientiertes Schulbild (Eb. 2; Übergeordnete Kategorie: Einstellungen zur Schule und zum Schulsystem) - Aus dem Kontext abgeleitet.
-  **Microsoft-Konto**
Fach-/themenabhängiges Lernen (Eb. 3; Übergeordnete Kategorien: Lernneigung (Eb. 2), Lern- und Hausaufgabengewohnheiten und -einstellungen (Eb. 1))

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Teilnehmer/in 4: #00:05:27-6# (...) Also die haben eigentlich schon alles gesagt. Was ich vielleicht besser finden würde, wäre, wenn man sich zum Beispiel die Fächer aussuchen dürfte. Zum Beispiel Fächer wie Musik oder was anderes. Und ja lernen ... naja, mag ich jetzt nicht so ... weil ich würde lieber andere Sachen machen.

Moderatorin: #00:05:52-7# Was zum Beispiel? Das wäre interessant.

Teilnehmer/in 4: #00:05:55-1# Keine Ahnung, irgendwas anderes.

Moderatorin: #00:06:02-7# (...) Gut. [Schreibt auf: Fächer aussuchen wäre gut]. Also, ihr dürft euch die Fächer nicht aussuchen, auch nicht später ... nur die Sprachen? Okay.

Teilnehmer/in 5: #00:06:20-8# Ich habe erst mal eine Frage. Meinen Sie die GSO oder Schule allgemein?

Moderatorin: #00:06:27-1# Okay. Ich meinte Schule allgemein, aber auch eure Schule. Also du kannst so antworten, wie du möchtest. Ob du die Schule allgemein magst aber diese Schule z. B. nicht unbedingt. Und dann vielleicht wäre das interessant zu wissen, warum nicht.

Teilnehmer/in 5: #00:06:51-9# Die Schule allgemein ist halt wichtig, aber man könnte das Schulsystem auch verbessern, damit es mehr Spaß macht. (...) Lernen tue ich nicht oft, aber weil ich es nicht muss. Aber ich denke, es würde mir Spaß machen, wenn ich öfter lernen würde.

Moderatorin: #00:07:19-9# Okay. Warum lernst du nicht so oft?

Teilnehmer/in 5: #00:07:25-7# (...) Ich muss halt nicht lernen. Ich schreibe trotzdem gute Noten, ohne zu lernen oder unendlich viel zu lernen.

Moderatorin: #00:07:32-7# Okay. (...) Also es ist nicht so, dass du das Lernen nicht unbedingt magst, sondern du brauchst das nicht immer. Stimmt? [Teilnehmer/in 5: Ja] Okay, danke.

Teilnehmer/in 6: #00:08:02-1# Also Schule macht mir jetzt nicht Spaß, aber ist halt wichtig so. Weiß jetzt nicht, was ich darüber so sagen kann. Aber zu lernen ... tue ich nicht. Halt macht mir keinen Spaß, weil es oft sehr viel Zeit benötigt. Ja...

Moderatorin: #00:08:25-0# Ja, das stimmt, das benötigt ein bisschen Zeit.

Teilnehmer/in 7: #00:08:32-6# (...) So ja, Schule ist halt wichtig, aber man könnte das verbessern, indem man weniger Hausaufgaben aufgibt und sich Wahlfächer auswählen kann, wie zum Beispiel statt Musik Übungsstunde.

Moderatorin: #00:08:50-2# (...) Also, Musik ist nicht so dein Lieblingsding.

Teilnehmer/in 7: Nein. Nein. Aber ich könnte mir aussuchen was ich mag.



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Declaration

I hereby declare that I have completed this dissertation independently and without any unauthorized assistance. I confirm that I have used only the sources and aids explicitly referenced within the text and that I have identified all ideas, excerpts, and citations that are not my own as such, in accordance with academic integrity standards.

I also consent to this dissertation being checked using appropriate software as part of any investigation into allegations of plagiarism.

Furthermore, I note that I sporadically used the free, limited-function version of Grammarly to identify grammar, spelling, or style errors.

Bremen, January 6, 2025

Cristina Greculescu