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Socio-emotional and cognitive development in learning. Educational goals in competition?!

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der Empirischen Bildungsforschung

Michael Becker, Charlotte Dignath, Lilly-Marlen Bihler,
Hanna Gaspard, Nele McElvany (Eds.)

Socio-emotional and cognitive development in learning

Educational goals in competition?!

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edited by Nele McElvany

Volume 9

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Preface

For a long time, research and teaching have primarily focused on students' cognitive development, with the aim of teaching all learners academic skills such as reading, writing, and arithmetic. However, in recent years—particularly since the COVID-19 pandemic and the associated school closures—there has been a growing recognition of the importance of students' socio-emotional development. Calls have been intensified to support students' well-being and mental health and to promote socio-emotional competences.

Despite the increased focus on socio-emotional development as an educational goal, it should be borne in mind that a significant number of students is still failing to meet minimum academic standards. Strengthening the basic academic skills of low-achieving students remains a critical priority in order to prepare them to participate equitably in society. Yet, prioritizing academic remediation could inadvertently undermine contemporary educational goals related to socio-emotional growth. Focusing mainly on the promotion of basic academic competences including mastery of basic reading, writing, arithmetic, and STEM skills might increase low-achievers' psychological stress, leading to a possible "vicious circle" in which pressure to achieve academically hinders the development of the psychological resources needed for effective learning.

These potentially competing perspectives on education—on the one hand, the imperative to develop basic cognitive skills, and on the other, the importance of nurturing socio-emotional skills—raise critical questions. How can these different educational goals be reconciled? Are these educational goals in conflict or to what extent can they support each other given certain conditions? What roles do socio-emotional aspects—such as motivation, emotions, and well-being—play in academic learning? How can we design effective socio-emotional learning programs, particularly for low-achievers or diverse learners?

The 9th volume of the series *Dortmund Symposium on Empirical Educational Research* (9. Dortmunder Symposium der Empirischen Bildungsforschung) explores these fundamental questions with a series of theoretical and empirical contributions. The volume explores the interplay of academic and socio-emotional development with a particular emphasis on promoting these areas in school practice.

The first chapter by Sara E. Rimm-Kaufman on *Socio-emotional learning: Promising synergies with academic learning in early adolescence* taps into the

implementation of socio-emotional learning in heterogeneous groups. This chapter outlines core definitions of social and emotional learning (SEL), describes the typical developmental trajectories of SEL—especially in secondary schooling—and highlights how well-designed classroom experiences enhance meaningful learning that simultaneously foster academic learning and meet the psychological needs of young people. It concludes with practical implications for educators seeking to integrate SEL into instructional practice.

In the second contribution, Elsbeth Stern presents the chapter *Learning and performance do not have to come at the expense of socio-emotional development*. The chapter stresses the importance of imparting practical and transferable knowledge, which calls for learning environments that meet the affordances and constraints of human information processing by supporting both cognitive and socio-emotional goals. A well-structured learning environment which adequately fosters cognitive development takes into account intelligence and reasoning ability, which, if approached systematically, also addresses the motivational side of learning and the diversity of learners.

The third chapter by Florian Schmiedek *Learning for at-risk students: A dynamic perspective* centers on students at a heightened risk for academic failure and socio-emotional challenges. The contribution highlights that variables related to achievement and socio-emotional aspects such as well-being and mental health are interconnected in complex, dynamic, and individual ways. The chapter cautions against overly generalized approaches and emphasizes the need to adopt within-person methodologies that capture individual learning dynamics over time. The contribution argues that methods such as dynamic within-person analyses should be used more frequently in educational research to provide more nuanced insights for both research and practice.

The second part of contributions highlights the role of specific socio-emotional constructs—such as emotions, well-being, and motivation—and their impact on learning. Anne Frenzel's and Thomas Goetz' chapter on *Learning and emotions* explores the reciprocal relationship between learning (and performance) and performance-related emotions. Their chapter underscores how learning environments that promote emotional development enhance cognitive development and vice versa. The authors also explain why competition between the two educational goals is more likely in a learning environment where performance is evaluated on the basis of social comparisons than in an environment that focuses on mastery in learning. The authors stress the central role of teachers as "instructors" rather than "examiners" to facilitate both emotional and academic development.

Carmen Zurbriggen's contribution on *Well-being and learning: Taking inclusive education as a prominent example* investigates the multifaceted links be-

tween school well-being and learning. Insights are not only provided on a theoretical level but also with a glimpse into current research on the relationship between school well-being and performance, as well as factors in the learning environment that can influence this relationship. Drawing on results from studies in the area of inclusive education, the chapter highlights that adaptive teaching and a supportive classroom climate have the potential to simultaneously enhance school well-being and performance in secondary education.

The volume concludes with Ricarda Steinmayr on *Learning and motivation: Which motivation is important and how to foster it.* She critically examines whether the widely held assumption that motivation is a decisive and easily malleable factor in school performance stands up to empirical scrutiny. The chapter unpacks the complex idea that motivation functions as an umbrella term for a variety of constructs that are linked to learning and performance in varying degrees, and discusses how various dimensions of motivation interact dynamically with factors such as teachers' attitudes and behaviors and students' emotions. This chapter offers evidence-based recommendations for identifying and fostering those motivational aspects most relevant for learning.

Overall, the contributions in the volume make a timely and important statement: Current educational research can enrich the multidimensional educational processes by simultaneously cultivating both socio-emotional and cognitive development. This dual focus recognizes learning as a multidimensional process that centers on the individual, while also emphasizing the central role of teachers and instruction to attain these goals for successful education. By addressing these aspects conceptually and empirically, the volume advances the broader goal of developing more inclusive, equitable, and effective educational systems.

Dortmund, November 2025

Michael Becker, Charlotte Dignath, Lilly-Marlen Bihler, Hanna Gaspard, and Nele McElvany

Part 1: Designing socio-emotional learning for heterogeneous groups

Sara E. Rimm-Kaufman

Socio-emotional learning

Promising synergies with academic development in early adolescence

1. Introduction

Picture Spring Middle School[1], a school serving youth between age 11 and 13 in a small northeast city in the United States. Historically, the city was mostly populated by white, middle- and working-class families and their children. Since 2000, the city experienced an influx of immigrants and now roughly 1 in 10 people in the city are immigrants (Office of New Americans Report, 2023). Now, Spring Middle School has about 480 students with 32 % born outside of the U.S., representing 28 different home countries. 47 % of the students speak a first language other than English and this school has 21 home languages represented. Students come from Guatemala, Burundi, Angola, Sudan, Ethiopia, Iraq, Honduras, Namibia, Gabon, Rwanda among others (LeClaire, 2022).

Like most U.S. middle schools, the school strives to meet the needs of early adolescents who are experiencing dramatic developmental changes in physical, emotional, cognitive, and social domains. What makes Spring Middle School particularly unique is the tremendous ethnic diversity of students and the varied needs of youth and families who are very recent immigrants. This scenario calls attention to a question: How can schools meet psychological needs *and* promote academic growth among youth with such a wide range of backgrounds and experiences?

The solution for this school has been complex. Instead of focusing on academic achievement as the sole focus, they broadened their goals to advance a three-dimensional vision of student achievement that includes mastery of skills and knowledge, cultivation of character attributes, and high-quality student work on topics that are relevant and engaging to their students (Berger et al., 2021). Engaging in Crew – daily meetings with about 15–20 students and one adult—is one practice that contributes to this multifaceted vision of student

1 Spring Middle School is a pseudonym.

success. Crew creates an opportunity for students to develop positive relationships with adults and other students, have courageous conversations about issues in students' lives, create a sense of community, experience belonging, and reflect on the purpose of school learning (Berger et al., 2021).

This anecdote sets the stage for a conversation about how schools can cultivate social and emotional competencies and create meaningful academic experiences. This chapter describes the basic definitions of social and emotional learning (SEL), explores typical trajectories of growth of social and emotional competencies (SEC), and examines the ways in which meaningful learning creates classroom experiences that optimize academic learning while also meeting the psychological needs of youth. The paper closes with implications for educators striving to meet the needs of early adolescents.

2. What is social and emotional learning?

The Collaborative for Academic, Social and Emotional Learning (CASEL) is an organization at the University of Illinois-Chicago that is the central-most hub in the U.S. for SEL research, practice and policy. The CASEL definition of SEL is "the process through which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions" (CASEL, 2025). There are two attributes of this definition that require careful attention. The definition points out that *all young people and adults* can experience SEL. This is important because many people assume that SEL is just for children and youth. In fact, SEL also occurs in adults. For example, when educators learn and apply new intercultural skills for working with students of color or recent immigrants, that represents an aspect of adult SEL.

A second attribute of this definition refers to what people *learn and can apply* – SEL involves the development of more than skills. SEL also involves new knowledge and attitudes that people acquire. For instance, in the U.S. there has been a movement to increase cultural responsiveness of SEL. To achieve this goal, educators have had to learn and apply new skills, develop new knowledge about cultures, and change their attitudes about people who were unfamiliar to them in the past (Wanless et al., 2023). All this is necessary before teachers are ready to apply these competencies in their classrooms.

By definition, SECs occur as a product of SEL. SECs fall into three broad categories: self-skills, social skills, and decision-making (CASEL, 2025), as shown in Figure 1. The broad category of self-skills corresponds to the intrapersonal

Figure 1: CASEL model showing the development of social and emotional competencies

competencies of self-awareness and self-management. *Self-awareness* refers to a person's ability to understand their own values, thoughts, and emotions and the ways these ideas link to their behavior. Self-awareness involves identifying one's own emotions, their personal and cultural assets, examination of one's own prejudices and biases, developing self-efficacy, a growth mindset and a sense of purpose. When an eighth grader describes themselves as viewing mistakes as a normal part of learning and indication that they need to try a different idea to solve a problem, they are demonstrating growth mindset, which is one aspect of self-awareness. *Self-management* refers to the ability of a person to regulate and manage their thoughts, behaviors, and emotions and to adjust those behaviors to match different contexts. Use of stress management strategies, managing strong emotions, existing self-discipline, showing initiative and directing their attention to personal and collective goals are examples of self-management. Codeswitching, the modification of one's behavior or way of speaking to match their immediate cultural environment, also requires self-management skills.

The broad category of social skills also has two subcategories and includes social awareness and relationship skills. *Social awareness* refers to the ability to understand the perspective of others, even if they are from cultures and backgrounds that are different than oneself. It involves an understanding that

other people have had different experiences than oneself and have beliefs and actions that derive from those experiences. It means showing compassion for others and understanding what was considered right in one historical period is not necessarily considered noble in another. Being able to identify injustices fits within social awareness. *Relationship skills* refer to people's ability to create and maintain relationships and manage social situations with diverse groups. A person with strong relationship skills can communicate well, listen carefully to others, work with others to solve problems, navigate conflict well, lead or follow, when the situation calls for it. Relationship skills can mean showing cultural competency, resisting negative social pressure, seeking or offering help.

The fifth competency is *responsible decision-making*, reflecting people's ability to make effective choices about one's own behavior in a variety of different situations. Responsible decision-making involves being able to think through the consequences of one's actions and how those actions will influence oneself, others, and society collectively. Responsible decision-making requires open-mindedness, learning how to size up complex situations and make judgments, and identifying and enacting solutions for social and personal problems.

Social and emotional skills, knowledge and attitudes are multiply determined. People learn these at home, school, neighborhood, through social media and via other social interactions. Because classrooms and schools are malleable, a great deal of attention has been given to SEL in those contexts, corresponding to the classroom and school effects described in Figure 1.

3. Educating for social and emotional learning

SEL is certainly not new. Educators have been teaching students manners, kindness, empathy, self-control, and other related skills for decades—even centuries (Osher et al., 2016). What is new is that efforts to improve youth SECs have become an explicit aspect of the school experience of children and youth. There are two main ways that SEL takes shape in schools – by introducing programs designed to enhance SEL or by using SEL-practices organically as a part of the culture of the school.

SEL programs are prevalent in the U.S. as evidenced by the $ 765 million spent on such programs between November 2019 and April 2021 (Tyton Partners, 2021). SEL programs typically include a paper or online manual, training, and coaching that can be purchased and used for in-service professional development. These programs can be described in a few main ways; some integrate SEL into academic instructional content, others offer free-standing lessons on SEL topics, yet others are school-wide approaches that involve classroom and

school-level activities designed to enhance students' attitudes, knowledge and skills while also striving to create a school culture that is conducive to learning social and emotional competencies. Programs can be implemented in individual classrooms or school-wide, depending on the program and district.

The adoption of SEL programs contrasts to SEL that occurs without programs in place. SEL can be naturally embedded into the culture of a school as teachers model social and emotional competencies toward students. For instance, when youth see respectful interactions among teachers and between teachers and other students, children learn how to interact with peers. Teachers cultivate emotion learning through the daily experiences of classroom life (e.g., a teacher getting frustrated and then talking aloud to calm themselves down when the technology is not working).

Whether SEL is delivered through a program or organically via the culture of the school, SEL can be universal and delivered to all students or targeted and designed for people with moderate or chronic, severe needs requiring intensive, one-on-one work between a school counselor or teacher and the student. Universal SEL resembles the idea of fluoride in water – it is an intervention that can benefit each and every student. However, many students need more intensive support to develop SECs, in which cases offering more one-on-one opportunities to touch base with adults or access to clinical services can address those needs.

4. Trends in social and emotional learning

Researchers at the RAND Corporation conducted a nationally representative survey of almost 28,954 teachers and 12,954 principals asking them to rate the importance of teaching a range of social and emotional skills (Hamilton et al., 2019). The survey asked about *self-skills* including understanding and managing emotions, setting and achieving positive goals, developing a sense of identity, *relationships skills* including establishing and maintaining positive relationships and feeling and showing empathy toward others, as well as *decision-making skills* such as making responsible decisions. For all skills measured, over 90 % of principals and teachers described these skills as fairly or very important. For most skills, 97–99 % of educators reported them as fairly or very important. The importance of SEL has been evident in recent policies with 27 states having state standards for SEL for grades K-12 in place as of 2022 (Dermody & Dusenbury, 2022).

On one hand, the U.S. has shown a rise in SEL priorities and policies yet there are counterforces at work, as well. SEL has emerged as a political flashpoint. Many conservative-leaning politicians and conservative parent groups

have pushed back on SEL stating that teaching social and emotional competencies is outside of the scope of schools and that youth should be learning those values from their families and religious organizations. Most left-leaning politicians and parent groups agree with the premises of SEL. Yet, some left-leaning scholars and educators raise issues because typical SEL is too focused on "mainstream" white U.S. values and does too little to adapt to cultural diversity present in the schools. For example, many strengths in students of color are not recognized as strengths nor are amplified by typical SEL (e.g., the ability of Black students to codeswitch) (Rimm-Kaufman et al., 2023).

SEL is not only a U.S. phenomenon. Many schools in Germany use SEL. Some programs focus narrowly on anti-bullying and anti-violence, for instance, whole school anti-bullying problems using approaches by Olweus (1993), the 'Faustlos' curriculum-violence prevention, the ProACT+E approach and use of the 'Fairplayer Manual' (Scheithauer & Bull, 2008). Other schools focus more broadly on cultivating SECs. For instance, Second Step has been adapted from the U.S. program to be used in Germany, as has the Mindmatters program. Yet other schools have focused on mental health needs of students by adopting programs such as Lion's Quest that supports adolescents' development of sense of self, teaches listening, empathy, and wise decision-making through a series of lessons (Cefai et al., 2018).

These are all examples of efforts to enhance social and emotional competencies. New meta-analytic work shows the ways in which SEL contributes to short- and long-term gains in social, emotional, academic and behavioral outcomes (Cipriano et al., 2023; Taylor et al., 2017). SEL approaches have garnered widespread attention impacting both policy and practice. Despite this focus, we know too little about how SECs change over time, especially during adolescence.

5. The development of social and emotional competencies

It is easy to assume that children and youth learn steadily and gradually as they mature. Achievement provides a basis for that assumption in that we know, on average, youth show gains in reading and math skills over time with the greatest magnitude of growth annually in early childhood and then smaller increases during the middle and high school years (Hill et al., 2008). Unlike achievement, youth development of SECs does not show a simple, upward trend. Instead, there are qualitative shifts in development that can lead to interruption and even U-shaped patterns (Soto & Tackett, 2015). Take self-management as an example. One longitudinal study (Ross et al., 2019) showed that self-management (e.g., deciding on a goal and sticking to it) was best modeled quadratically;

self-management decreased from age 10 to age 17 followed by an increase to age 18.

Findings like this question assumptions in the field. Before investigating further, there are important issues related to measurement of these constructs to raise. Some SECs, such as self-efficacy or growth mindset, can only be assessed through student-report which means outcomes reflect actual presence of SECs as well as students' perception of themselves relative to others around them. Interpretation of student-report data has some advantages, for instance, the work elevates youth voice and helps researchers understand students' actual lived experience. However, student-report also introduces bias based on the variation in students' internal appraisal of their competencies.

To pursue inquiry about how SECs develop, the author (S. Rimm-Kaufman) and two colleagues (J. Soland and M. Kuhfeld) identified an ideal data set. A group of California school districts called the CORE districts started conducting annual surveys about youth's development of SECs in 2015 (West et al., 2018). These data were available to researchers for analysis and were ideal because of the large sample and use of standardized measures.

Thus, the paper by Rimm-Kaufman and colleagues (2024) was designed to better understand developmental trends in SECs. The study was informed by the Stage-Environment Fit Theory (Eccles et al., 1993) which posits that developmental declines in motivation and perception of self in adolescence "result from a mismatch between the needs of developing adolescents and the opportunities afforded them by their social environments" (Eccles et al., 1993, p. 91). Despite the theory being thirty years old, early adolescents still experience a problematic stage-environment fit. Early adolescent youth develop more need for autonomy and become very sensitive to social comparison, yet they continue to need close relationships with adults (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019; Yu et al., 2018). Further, young adolescents desire respect and status and traditional schooling can seem uninteresting as they develop a fundamental need to use their skills to improve the contribute to the world around them (Fuligni, 2019). Just as these developmental changes are occurring, most youth are moving from elementary to middle school. In elementary school, students typically stay in a classroom with one adult and roughly 25 students. In middle school, students typically move from classroom to classroom and teachers have as many as 130 students in any given day. The demands of middle school are high – teachers expect students to come to class prepared, open only certain tabs on their computer without being distracted by the internet, and work on long term projects without waiting until last minute to complete them. Middle school also means high-stakes grading, ability grouping, more disciplinary action, and an increase in the public eval-

uation of academic work (Deutsch, 2022). Taken together, this new context creates a challenge for the developing child. To pursue deeper understanding of development of SECs, analyses were conducted to examine how much growth occurs in social and emotional competencies from Grades 4–12?

6. Quantitative analysis and results

The CORE data collection included nine districts in California that administered surveys to all students each year starting in 2015, resulting in a sample of 95,998 students in grades four through 12 (roughly ages nine to 18). Collecting data each year resulted in longitudinal data for up to four years. Thus, the analysis included students who took the survey at least once between 2015 and 2018. The sample of students was almost evenly split between girls (49 %) and boys (51 %).[2] Roughly 25 % were from families with parents with low educational attainment (i.e., high school or below). The sample was 73 % Latine, 11 % White, 10 % Black, and 7 % Asian.

Table 1. Measures Collected in the CORE Districts with Selected Items

Constructs	Example Items	# items	Alphas
Growth Mindset	I can change my intelligence with hard work. I am capable of learning anything.	4	.70
Self-Efficacy	I can master the hardest topics in my classes. I can do well on my tests, even when they are difficult.	4	.86
Self-Management	I came to class prepared. I paid attention, even when there were distractions.	5	.85
Social Awareness	How often did you compliment others' accomplishments? How well did you get along with students who are different from you?	5	.81

The 18-item measure administered assessed growth mindset, self-efficacy, self-management, and self-awareness, as shown in Table 1. To address the key re-

2 Gender data were limited to binary categories of girl and boy.

search question, an Accelerated Longitudinal Design (ALD) Growth Models was used. First, multilevel growth curve models were estimated and then linear, quadratic, and cubic growth curves were tested. See Rimm-Kaufman et al. (2024) for more details.

For three of the four constructs, findings showed a shift in students' perceptions of their intrapersonal and interpersonal competencies around 6th or 7th grade. Figure 2 shows the patterns. Results for growth mindset generally showed increases in scores over time. Self-efficacy showed a somewhat different pattern: students tended to show consistent declines as they moved from 5th to 6th grade and beyond, but that trajectory flattened or even curved upwards in 11th and 12th grade. For self-management, students were level in 4th and 5th grade, then showed declines between 6th and 8th grade, followed by increases in late high school. For social awareness, students showed declines between 6th and 8th grade, and, then increases from 9th through 12th.

Yet another point requires attention. The models indicate considerable student-level variability in the latent slope parameters suggesting that growth in

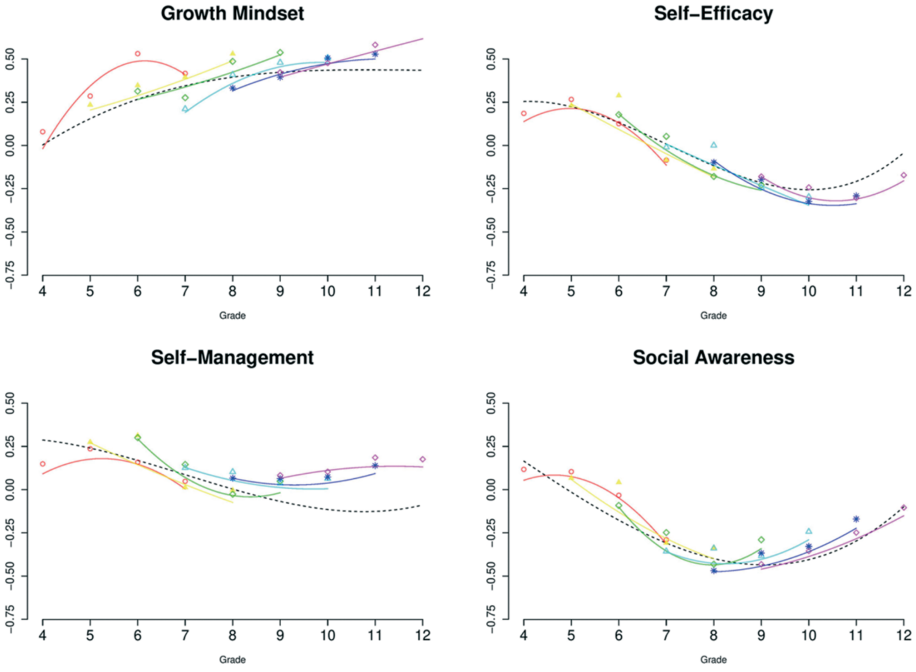

Figure 2: Plots of Model-Based Growth Estimates by Construct
Note: The dotted black line represents the model-implied trajectories using the accelerated longitudinal design. The other lines each represent cohort-specific estimates. The Y-Axis is the number of standard deviations from the average in grade 4. Reprinted from Rimm-Kaufman et al. (2024, p. 366).

these constructs differs considerably dependent on the student. For example, while students tended to decline in self-efficacy in the early grades, a non-negligible percentage showed growth during those years. To describe this phenomenon quantitatively, as an example, the mean of the linear slope for growth mindset was .17 SDs. If one were to take the square root of the slope variance, it would equal .4 SDs. Thus, a student approximately 2 SDs above the slope mean would have a linear coefficient of .97 SDs, and a student 2 SDs below the slope mean would have a linear coefficient of -.63 SDs. Examples like these indicate that relying only on averages masks considerable variability in these SEC trajectories, a point discussed further in Rimm-Kaufman et al. (2024).

7. Changes in SECs

SECs develop in relation to one another and changes in one developmental domain influence another domain. As an example, the findings show a gradual decrease in self-management from 4th through 11th grade with a slight uptick between 11th and 12th grade, findings that match other longitudinal work (Ross et al., 2019). Also, during early adolescence, the demands of school and the need for self-management intensifies as students shift to middle school. Middle schoolers may perceive drops in their self-management because of the heightened demands. In the presence of dips in self-management, self-efficacy is also likely to drop (Musci et al., 2022). Lower self-management and feeling inefficacious may create stressful situations that means youth will put their own needs first and show lower social awareness.

These developmental changes occur in context of students' school experiences. Middle schools tend to be larger than elementary schools. Youth are rating themselves in comparison to others just as their comparison group grows to include a wider social circle at school and likely, online. Growth mindset is an anomaly in that it shows continued growth. Growth mindset interventions have become more common in school, which may be one possible explanation. Another plausible explanation is that some aspects of intelligence (e.g., vocabulary, working memory) increase during the teen years (Hartshorne & Germine, 2015).

The declines in self-efficacy, self-management and social awareness have consequences for action among the educators who are a part of youths' developmental experience. Youth are at a turning point. If adults offer scaffolding to meet the new demands and show positive regard for youth, students will remain engaged in learning. If adults respond with discipline and blame, negative relationships will emerge and students will disengage from school (Engels et al.,

2016; Hughes & Cao, 2018; Thomas et al., 2025). The interconnection among the SECs and the dynamic interactions between youth and their environments calls attention to the importance of Stage-Environment Fit for youth to thrive and raises a question: What is it that educators can do to create school environments that improve stage-environment fit? As shown in Figure 1, youth have experiences in classrooms (e.g., SEL instruction, classroom climate) and schools (e.g., schoolwide culture, practices and policies) that contribute to increases (or declines) of SECs. EL Education (formerly Expeditionary Learning) is a school model designed to improve middle school, as described below.

8. Can school-wide SEL approaches meet the needs of early adolescents?

To address this question, we explore a school-wide approach to teaching called EL Education. EL Education has developed curriculum, and a training and accreditation system that allows for schools, both public and private, to engage in their model. EL Education developed a theory of change that states: "when students are engaged in work that is challenging, adventurous and meaningful, learning and achievement flourish" (Berger et al., 2021).

EL Education emerged in 1991 from a partnership between Outward Bound, an organization that focuses on self-exploration, teamwork, courage and compassion in youth, and the Harvard Graduate School of Education. There are 150 schools in 30 states from around the U.S. that use the EL Education school-wide model. In addition, many U.S. schools use components of EL Education but not the school-wide model (see https://eleducation.org/).

EL Education has several signature practices. Learning expeditions are a key EL Education curricular structure. These long-term, in-depth studies resemble project-based learning and/or service-learning. Expeditions offer real-world connections that inspire students toward higher levels of academic achievement. Learning expeditions involve students in original research, critical thinking, and problem solving, and they build character along with academic skills. Crew refers to the daily meetings that occur across the school with each Crew involving about 20 students and one adult. Crew focuses on community-building, academic accountability, and civically engaged activities that contribute to the school or broader community.

Students' character development is a crucial part of the EL Education model and is as important as producing high-quality work and mastering knowledge and skills. By design, EL Education strives to support students to become ef-

fective learners, ethical people, and contributors to a better world, which EL Education define as "three aspects of strong character."

Yet another hallmark attribute of EL Education is the goal of establishing partnerships in historically underserved areas, particularly with high percentage of youth of color, high percentage of students from families with low educational attainment, and many students identified as having special needs (SEN).

Starting in 2019, Sara Rimm-Kaufman, Lia Sandilos and their team conducted a two-year quasi-experimental study of the EL Education model. Upon joining the team, Allison Ward-Seidel, a doctoral student embedded a mixed methods study to better understand one aspect of the EL Education model – the premise that instruction needs to be designed in ways that give students purpose and agency. This work investigates meaningful work, defined as "relevant content, favorable conditions for learning, and positive social interactions" (Ward-Seidel et al., 2024, p. 3). Meaningful work fits into the CASEL model in Figure 1 and corresponds to features of classrooms and schools.

Two research questions were addressed: 1) To what extent do students at EL Education middle schools experience school as more or less meaningful than students at comparison schools? Is this difference present for Black and Latine youth? 2) How do middle school students describe meaningful school experiences? Do these definitions differ between EL Education and comparison schools?

A sequential explanatory mixed methods design was used involving survey data were collected in the first year (n=258) and then follow up interview data in year 2 (n=32) to explore and explain findings. For the quantitative data collection, study participants were 5th and 6th grade youth across nine schools in the U.S. Five schools were using the EL Education school-wide model and were compared to four comparison schools that were similar in demographics and in the same city as the EL Education schools. In total, 258 students participated in the study (107 EL Education, 151 comparison).

Based on family-report data (typically parent-report), students were 49% male, 47% female, 2% gender non-binary, 1% missing gender; 41% Black, 33% White, 16% Latine, 6% Multiracial, 1% Asian, 0.4% Native American, 3% missing; 31% from families with low income, 53% not low-income, and 17% missing. Eleven percent of students were students with special needs (SEN) and 13% were English Learners. Students were surveyed on their school experiences between January and March 2020 at their school. Due to COVID-19, some surveys were sent home to youth after the pandemic began. (Pre- versus post-pandemic shut down was noted as a variable and treated as a covariate in the analyses.)

Data collection occurred in two phases. In Year 1, student participants re-

sponded to four questions about students' sense of purpose at school using the Revised Youth Purpose Survey (Bundick et al., 2006). Participants rated four items (α = .97) on a Likert scale from 1 (not meaningful at all) to 5 (extremely meaningful). The survey included questions such as: How meaningful do you find participating in class? How meaningful do you find working with others at school?

In Year 2, purposive sampling was used to select students for follow-up interviews. The resulting sample included 32 6th and 7th grade youth; 20 were EL Education students and 12 were enrolled in comparison schools. Students reported gender and race/ethnicity with 50% girls, 44% boys, and 6% gender non-binary; 44% Black, 47% White, 6% Latine, and 3% multi-racial. According to school administrative data, 31% were from families with low income, 16% students were SEN, and 6% were English learners. The interviews were conducted via phone call from March – July 2021 and lasted 20–40 mins. Students were asked the following interview questions using a semi-structured interview protocol: Think about work that you do at your school. Does it feel meaningful and important to you? Can you give an example of work that you have done at your school that is meaningful and important to you? Tell me more about that work and why it felt meaningful and important to you. Could you see the purpose of that work?

8.1 Quantitative analysis and findings

The quantitative results showed that on average, EL Education students rated their school experiences as meaningful at a 3.12 on a scale of 1 to 5 (SD = 1.25). Comparison students rated their experiences at a 2.9 out of 5 (SD = 1.25). Regression analysis showed that students in EL Education schools reported significantly more meaningful school experiences than students at comparison schools (b = 0.26; SE = .12; $p < .05$). Race/ethnicity, post-COVID, and age were also significant predictors of students' reported meaningfulness at school.

Comparable analyses were conducted on subgroups of students. Findings showed that among Black students (n=107), those in EL Education reported significantly more meaningfulness in school than their Black peers in comparison schools (b = 0.83; SE = .27; $p < .05$). This was also true among Latine students (n=34): those in EL Education schools reported significantly more meaningfulness in school than their Latine peers in comparison schools (b = 0.84; SE = .14; $p < .05$).

8.2 Qualitative analysis and findings

Qualitative analyses were conducted to explore and explain these quantitative findings. Once transcription of the interviews was complete, four research team members followed a descriptive-interpretive approach to identify themes that emerged related to students' perceptions of meaningfulness of school, work that is fully described in Ward-Seidel et al. (2024). Three themes emerged including the following: (1) sociopolitical development (i.e., real-world issues and development processes); (2) engaging schoolwork (i.e., content in school was personally relevant, hands-on, or socially interactive); and/or (3) future-oriented (i.e., teaching academic skills, social-emotional skills, goal-oriented skills); each are described below.

Sociopolitical development. The most prevalent theme related to youth's sociopolitical development focused on the content of *what* students were learning. Students found real-world issues meaningful in their learning. Variations within this theme included: racism, environmentalism, gentrification, feminism, human rights, and historical events. Almost one third of the students (31%, *n*=10) described meaningful schoolwork as working on activities that address real-word issues. More EL Education students (45%, *n*=9) mentioned this theme than comparison students (8%, *n*=1). As one student described:

> *"Because I feel like, how do I say this,* ***they try to connect it with real problems in the world****. Because the other day, I think last quarter, we were learning about gentrification. And we learned about all the problems and what's happening around the world, and how you can relate to it because we live in DC. That's a big problem. So yeah.* ***The work informs us, basically, of what is actually happening in the world, but also learning from it.*** *And when you know and you can relate to that, it makes you remember. And how we could make a difference in the world and all that stuff. And yeah."* (Teri, EL Education)

An equivalent percentage of youth (31% of the sample, *n*=10) related to the theme of youth's sociopolitical development but focused on the content of *how* students were learning. For instance, themes including awareness/reflection, efficacy, and action and activism were common in their description of meaningful learning. As one example:

> *"It all connects to,* ***what's our life like right now****… when Ruth Bader Ginsburg [a U.S. Supreme Court Justice] died, we were learning about her… some students made posters for her, some students made a slideshow about her and we also did another 'inspirational topics.' We picked an inspirational person and then connected it to how we find it inspirational."* (Edie, Comparison)

Processes of sociopolitical development were more common in EL Education (45%, *n*=9) than comparison schools (8%, *n*=1).

Engaging schoolwork. Engaging schoolwork was a theme that emerged in more than half of the students interviewed (56%, *n*=18). Specifically, work was deemed meaningful if it was personally relevant (25%, *n*=8), hands-on (22%, *n*=7) or socially interactive (13%, *n*=4). This theme was more prevalent among EL Education students (75%, *n*=15) than among comparison students (25%, *n*=3).

One student gave two examples of how socially interactive experiences made learning meaningful. First, she said that a morning meeting was meaningful "Because [I] got to talk in front of the whole middle school." Second, she said that her experiences "focusing on the community commitments [are] meaningful because they make me and a lot of other people feel safe in our learning environment" (Genny, Latina female, EL Education).

Future orientation. Approximately half the sample (47%, *n*=15) reported meaningful schoolwork as developing skills that would be useful in their future. These included academic skills (e.g., math for taxes), social-emotional skills (e.g., relationship building, empathy, respect), or goal-oriented skills (e.g., developing goals for getting good grades to get into college). EL Education and comparison students mentioned this theme equivalently (45%, *n*=9 of EL Education; 50%, *n*=6) of comparison students. As one example,

> *"I mean it's important that we're learning this stuff because …* ***it's just good to have like a wide variety of things that you know you can do for the future****. And if we're learning about kindness then it's good to just be kind."* (Kate, EL Education)

Several key findings emerge. First, the findings demonstrate that school-wide changes that connect SEL and academics *can* produce more meaningful learning for youth. In this case, students at EL Education schools found working with others at school, studying and doing homework for class, participating in class and doing school projects were more meaningful than students at comparison schools. The differences between EL Education and comparison schools were particularly prominent for students of color (Black, Latine). Often, schools strive to create equity by improving the quality of experiences in school, particularly to better meet the needs of students of color. EL Education appears to be successful in this goal.

Findings also reveal ways that educators can meet the needs of developing youth by refreshing their curriculum so that learning is more meaningful. Example practices include: focusing content on contemporary issues, engaging in processes that enervate sociopolitical development (enhancing reflective prac-

tices, enhancing awareness of contemporary issues, creating opportunities for efficacy, action and activism), using socially interactive activities, and linking learning to students' future goals.

9. Call to action

The anecdote at the start of the chapter aligns with the Stage-Environment Fit Theory and exemplifies the synergy between academic and social-emotional learning (SEL). Early adolescence is a particularly vulnerable period when youth often perceive their SECs as lower than in the late elementary school years. Classrooms and schools can respond during this delicate time by providing supportive learning experiences that are well-matched to youths' developmental needs. Further, this match seems most important for youth who have experienced marginalization because of their race/ethnicity. The findings here highlight that the highest quality practices geared to create meaningful learning may matter most for youth of color, thus resulting in recursive cycles of meaningful engagement in learning that leads to affective connection to school contexts and academic achievement (Thomas et al., 2025).

Decades of research underscore the value of caring and responsive teachers, a sense of classroom community, and rich opportunities for SEL (Durlak et al., 2025). While these features are necessary, they are not sufficient for academic learning. Educators can leverage caring and responsive classroom experiences to enhance academic learning by recognizing the unique features of adolescence, especially those youth who tend to be underserved in educational settings. By building classroom environments that meet students' social, emotional, and academic needs, educators can make learning *matter* for youth.

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Elsbeth Stern

Learning and performance do not have to come at the expense of socio-emotional development

1. Introduction

All subjects taught in school aim to foster meaningful learning and conceptual understanding. The knowledge acquired in the classroom is supposed to enable students to better understand the world around them, as well as to develop and achieve short-term and long-term goals. The reality, however often looks different: Students acquire knowledge that is bound to the narrow context of the classroom, which means they do not achieve a deeper understanding of the content dealt with. If at all, students can retrieve the knowledge in the next exam, but its isolated representation in long-term memory makes it unlikely to be activated in new contexts inside and outside of school (Mähler & Stern, 2006). This is detrimental for students, teachers, parents and society as a whole. It is particularly frustrating for students to experience day after day that they have to learn things that they do not understand and whose intellectual or practical benefits they cannot comprehend. These experiences will most likely create feelings of helplessness and belonging uncertainty (Cohen, 2022), which has a long-term impact on students' socio-emotional development and impairs their further academic development (Baumert et al., 2023).

Providing an education system that meets the needs of society and at the same time benefits the broad variety of learners, is one of the greatest challenges in the modern world. Scientific progress made in various areas related to learning and education can help to better understand the challenges of providing learning environments that support children in developing positive attitudes to performance and equipping them with self-efficacy. Three lines of research, which will be discussed in detail in this article, can contribute to this goal:

a) Preparation for future learning instead of short-term effects: Promoting the acquisition of usable and transferable knowledge. Schools were founded because skills such as reading, writing and arithmetic have evolved over the course of cultural development and need professional instruction to be passed to the next generation. Therefore, learning at school is by definition more demanding than the acquisition of skills for which evolution has prepared us. At the same

time, we have not yet exhausted the opportunities for facilitating learning that the learning sciences offer us. By providing learning environments that meet the affordances and constraints of human information processing (Schumacher & Stern, 2022), learners are more likely to have successful experience and thereby gain self-confidence and self-efficacy (Yu & Schunn, 2024).

b) Creating motivation by promoting mastery instead of performance orientation: In contrast to everyday concepts held also by many teachers, for Psychologists motivation is rather a state than a trait. This means that learners' motivation can be influenced by teachers, and this does not have to be done by lowering standards. The self-determination theory (Deci & Ryan, 2012) provides the framework for this.

c) Managing diversity in cognitive abilities, prior knowledge, interest and social background. When entering a class, students do not start at the same level, and they often end up even more diverse. In particular, cognitive abilities as measured with intelligence tests are a stable personality trait with a strong impact on learning outcomes (Stern, 2017; 2024). Managing diversity to the benefit of all is a major challenge for teachers, which needs more attention.

2. Preparation for future learning instead of short-term effects: Promoting the acquisition of usable and transferable knowledge

Effective learning environments have to consider affordances and constraints of the human minds. Thanks to scientific progress in cognitive science, we now have a solid understanding of how the human mind works and how learning can be promoted. To avoid frustration among students and teachers, learning material and instructional interventions must consider how incoming information is encoded, stored and retrieved. In the interests of efficient learning environments, the multi-store model of human information processing agreed on by psychologists should be taken into account in all educational activities. Sensory memory is the earliest stage of processing the large amount of continuously incoming information from sight, hearing and other senses. In order to allow goal directed behavior and selective attention, only a fractional amount of incoming information passes into the working memory, which is responsible for temporarily maintaining and manipulating information during cognitive activity. The special architecture of working memory is one of the unique features of humans. What the cell is for Biology and the molecule is for Chemistry is working memory for Psychology, as this construct can broadly explain what controls human behavior (Stern, 2024). The limited capacity of working memory allows control of attention and thereby enabling goal directed and

conscious information processing. Working memory is the gatekeeper to the long-term memory, which is assumed to have an unlimited capacity. Here, information acquired through experience and reasoning can be stored in different modalities as well as in symbol systems (e.g., language, script, mathematical notation systems, pictorials, music prints). Working memory enables intentional information processing by focused attention, but it can also process incidental information. The multi-store model of human information processing is not at all a one-way street, and long-term memory is not to be seen as a storeroom or a hard-disk where information remains unaltered once it has been deposited. A more appropriate model of long-term memory is a self-organizing network, in which verbal concepts, images, or procedures are represented as interlinked nodes with varying associative strength (Stern, 2017).

Working memory regulates the interaction between incoming information from sensory memory and knowledge activated from long-term memory. In case of very strong incoming stimuli (e.g., a loud noise or a harsh light), working memory activities will be interrupted. For the most part, however, working memory is guarding against incoming information to make sure that goals that have been set will be achieved appropriately. This means, working memory is continuously busy with selecting incoming information, aligning it to knowledge retrieved from long-term memory, and preparing responses for accomplishing requirements demanded by the environment. Inappropriate and unsuitable information intruding from sensory as well as from long-term memory has to be inhibited, while appropriate and suitable information from both sources has to be updated. These working memory activities permanently change knowledge represented in long-term memory by adding new nodes and by altering the associative strength between them. Working memory activities are intertwined with the context as well as with the knowledge stored in the long-term memory. One of the most important insights from the learning sciences is that prior knowledge is the most important predictor of future learning. Successful teaching means to provide learning opportunities that meet with prior knowledge.

Psychologists have agreed on distinguishing between declarative (knowing that) and procedural (knowing how) knowledge. Declarative knowledge can be communicated because it is represented on the basis of symbol systems (language, script, mathematical or visual-spatial representations). It is the basis for constructing meaningful conceptual knowledge through processes of inference and elaboration. In contrast to declarative knowledge, procedural knowledge can be directly applied to perform a task, and it includes motoric actions like driving cars as well as mental actions like algebraic transformations. Procedural knowledge emerges as a consequence of repetition, by which single ac-

tions become increasingly integrated into a coordinated series of actions. If the association between these actions is strong enough, they can activate each other and therefore only need a minimum of working memory functions. Because automated knowledge is at most partly open to conscious inspection, it can hardly be verbalized, and is resistant to modification. Mastery of any academic content area requires procedural and conceptual knowledge. Both kinds of knowledge are strongly intertwined (Schneider & Stern, 2010), but they are acquired through different mechanisms. Procedural knowledge is acquired by condensing single pieces of knowledge into broader units. The repeated execution of actions composed of single steps results in automated procedures. The repeated presentation of sets of small single stimuli may result in putting them together to a meaningful whole, which is called a chunk. Once chunks and procedures are created, they can be processed with low memory requirements. Transforming single letters into words is an example of chunking.

Conceptual knowledge, on the other hand, represents meaning, what can show up in classifications, principles, generalizations, theories or models in a content area. It can be communicated via symbol systems and it is constructed through reasoning that has been stimulated in interactions with other individuals, written material or other media. Engaging with content in this way is a challenge to working memory – in particular for areas that are mainly based on abstract concepts, as it is the case for many STEM areas.

How to promote usable knowledge

The goal of academic learning is the acquisition of usable knowledge that is flexible enough for transfer and problem solving. Usable knowledge is composed of procedures and chunks to relieve working memory functions which can then be used for grasping the gist of a problem. Content areas and academic disciplines differ in the composition of both kinds of knowledge, and this may affect the importance of intelligence for achieving expertise. Typical areas of expertise which are primarily characterized by the formation of chunks are reading and chess. Learning from texts is effective if working memory resources are available for processing the content instead of decoding letters. Experienced readers have chunked letters into words and patterns of words and therefore can concentrate on the content. Expertise in chess is gained by chunking single chess positions into broader units which can be recognized and stored with minimum working memory resources. Also, in broader disciplines, chunking is essential and reflects expertise. The audience of my lecture on "Human Learning" are master's students from different STEM areas. To demonstrate the impact of prior knowledge on memory, I show my students pictures presented in Figure 1

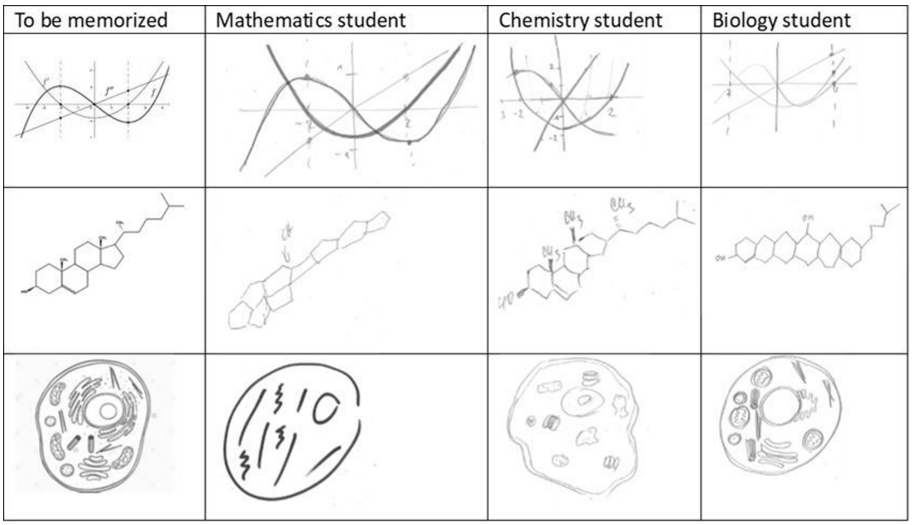

Figure 1: The pictures presented in the left column present important concepts from Chemistry (cholesterol molecule), Biology (animal cell) and Mathematics (first and second derivative of a polynomial function). The pictures were presented for a few seconds to STEM students with different disciplinary backgrounds, who were asked to draw them afterwards. Examples of the drawings from the students are presented in the cells to demonstrate the importance of prior knowledge for memorizing complex information.

for a few seconds and then ask my students to draw them. The pictures represent concepts that make sense to experts in the field, while being more or less random to others. This becomes obvious in their drawings. Depending on their disciplinary background, they either reproduce the image exactly or provide a rough sketch that lacks key conceptual features.

Automated procedures and chunks are necessary but not sufficient for mastering broader academic areas. STEM disciplines as well as humanities are cultural achievements and mastering them means understanding statements expressed in symbolic systems such as language, writing, formal notations, pictorial and graphical representations. Competence is evident in these areas by building a network of interconnected but distinct concepts, which provide the basis for deductive, inductive, and analogical reasoning. Such cognitive processes enable transfer of knowledge to new situations and problems, which is a challenge for all learners, no matter how intelligent they are. The difficulties have been best explored in mathematics and the natural sciences, especially in physics. Here students not only have to learn new concepts, as it is the case for all academic fields, but they must also restructure the meaning of many expressions used in daily life, among them concepts like force or energy. Math-

ematics is based on theorems and relations between numbers and figures that are derived by deductive reasoning.

Learning environments are effective if they meet with students' prior knowledge and address learners' deficits either in terms of conceptual misunderstandings or in terms of a lack of chunking and automation. In the past decades, learning sciences have developed and systematically evaluated so called means of cognitive activation that can be implemented in instructional units. These means have in common that they intend to face learners with deficits and misunderstandings regarding their prior knowledge (Schumacher & Stern, 2022). Presenting learning material that requires systematic comparison between superficially similar but conceptually different situations can help to extract abstract concepts. Prompting self-explanations or asking metacognitive questions raises learners' awareness of their prior knowledge, including deficits and misconceptions. Thanks to progress in digitization, teachers now have methods like formative assessment at their disposal which allow them to diagnose their students' deficits and provide them with appropriate learning opportunities. A second grader may answer "7" when asked: "What is a quarter of 32". A teacher may conclude that the student does not master multiplication tables properly and therefore asks the student to just practice. However, by asking the student to explain why he ended up with seven may shed light on severe conceptual deficits: "A quarter is always 25, and 32-25 results in 7". In this case, the concept of "quarter" has to be addressed. "Knowing what students know" is the key to better adapt learning opportunities to students needs and saves a lot of frustration for students and teachers. This kind of cognitive empathy on the part of the teachers can be expected to promote students' social-emotional development.

3. Motivation: Promoting mastery instead of performance orientation

Many teachers complain about their students' lack of motivation, as they have the feeling that no matter what efforts they make, students are not willing to get involved. At best, they develop extrinsic motivation, i.e. they work towards passing the exam or getting the best grade with minimal effort. Such experience suggests that motivation is a fixed individual characteristic rather than a malleable state. Such attitudes are supported by messages delivered by some psychologists, e.g. by Duckworth et al. (2019), who emphasizes that a student's grit – their passion and perseverance for long-term goals – is decisive for her learning outcomes. Precondition for developing grit is to develop passion and interests and to cultivate deliberate practice. The emphasis on passion and in-

terest is also in line with an attitude held by many teachers (Lazarides et al., 2023). What all these beliefs have in common is that they see the causes for a lack of motivation primarily in the learners, which is of course a relief for teachers. However, motivation research has a much more differentiated view, which considers the context in which learning takes place. While intrinsic motivation is a desirable goal, it would be unrealistic to expect it in every subject at any time. Students have developed their own pattern of interests and time allocation, which is at least partly desirable because they have to pave the way for their career paths. Rather than expecting students to enter the class with intrinsic motivation, teachers have to be prepared for less enthusiastic learners. Learning opportunities can be designed in such a way that students engage with the content, even if they are not too enthusiastic about it.

The Self-Determination Theory (SDT) from Deci and Ryan (2012), which emphasizes the importance of conditions supporting the individuals' experience of autonomy, competence, and relatedness, provides a framework for designing such learning environments. Learners' autonomy is violated if they have no idea of the benefits from participating in the curriculum, either in practical terms or in terms of intellectual insights. By starting a learning unit with a question that cannot be answered initially but will be so at the end can contribute to the feeling of autonomy. Also, giving learners some freedom to choose among the elements of the learning unit (e.g., problems to work on, texts to read, experiments to do) can increase the sense of autonomy. Learning is hard work and can be exhausting. Experiencing progress is key to maintaining the motivation to focus on further progress. Constantly experiencing failure is frustrating and will likely make students give up. Tailoring practice problems to students' achievement level allows them to make progress with some effort. Applying means of formative assessment can help to support mastery instead of achievement orientation in two ways. First, it allows teachers to identify students' difficulties and to present tailored problems, and secondly experiencing that teachers are interested in students' state of knowledge without judging it gives feeling of relatedness (Lichtenberger et al., 2024).

4. Managing diversity

In the early 20th century, a pragmatic need for predicting the learning potential of individuals initiated the development of standardized tests. When compulsory schooling had become common more than a century earlier, the tremendous differences in learning potential became obvious. The need for a qualified workforce led to an extension of higher education and required valid and reliable forecasts of performance potential in as yet unknown areas. Reasoning

abilities, as they were tested in intelligence tests, revealed stable individual differences. Intelligence is now understood as a polygenically inherited uniform personality trait with a high reaction norm, which follows the normal distribution, and which has a strong impact on the use of learning opportunities, and which explains individual differences in numerous outcome measures (Stern, 2017). In the past decades, numerous intelligence tests have been developed and standardized, appropriate for different diagnostic purposes, among them in educational contexts. Moreover, tremendous progress has been made in explain the neuro-cognitive foundations of differences in intelligence, which also have implications for educational decisions. The progress made in basic as well as in applied psychology calls for the education system to be analyzed in the light of intelligence research.

4.1 Intelligence and educational choices

Different from the Anglo-American world, in Central Europe standardized reasoning tests are rarely ever used for educational decisions beyond admission to special education programs. In the US and the UK, standardized university admission tests that show high correlations with intelligence tests. The same was formerly true for the admission to the grammar school in the UK, which was regulated by the 11+ examination. In central Europe, admission to the university is still mostly regulated after elementary school by assignment to academic track schools (Gymnasium), and the decision is mainly based on grades and parents' request. Those who do not go to the Gymnasium (depending on countries and regions [50–80 %]) go to regular schools supposed to prepare for vocational education. While intelligence-based tests are rarely ever directly used for educational track choices, the substantial correlations between school grades and test scores of r = .50 (Roth et al., 2015) raise the question, to what extent intelligence indirectly prevails. In recent decades, numerous studies have revealed a considerable impact of the family background on educational trajectories, which is often more important than cognitive competencies, as many studies show (Blossfeld et al., 2016). Such trends are neither compatible with the values of a meritocratic society, nor do they raise hopes for economic stability and innovation. Considering the stable differences in cognitive abilities in the overall school system as well as in concrete classroom practice is a permanent challenge in education that has not yet met with much success.

Meeting the different needs of a heterogeneous group of learners is inevitably accompanied by under- and overload for many learners. Ability-grouping on the other hand goes along with misallocation, as even the best tests are far from perfect in terms of validity and reliability. Giving everyone the opportunity to

realize their potential without setting the course too early must remain the goal. Intelligence tests can help with this, but their informative value should not be overestimated. Individual differences in learning potential are already obvious in primary school, where the focus is on basic cultural competencies like literacy and arithmetic supposed to be mastered by almost all members of a society. However, even if this goal is reached, differences in the time needed to achieve a particular performance level are obvious. From elementary school onwards they can be traced back to differences in more general cognitive capabilities (Schneider et al., 2014). At some point, it will no longer make sense to teach pupils together. This will be the case at the latest when more demanding content is on the agenda, which will overtax a significant proportion of the students.

In current Anglo-American countries, the educational decisions made during childhood are less drastic, although here too the path has been forged ahead. The subjects chosen in high school as well as the learning outcomes in these subjects have a strong impact on performance in college entrance tests (Allensworth & Clark, 2020). Both systems have pros and cons which will not be discussed here in detail, as there is no silver bullet available on how to deal with the diversity in intelligence. However, there is a justified concern in all systems that, in cases of doubt, social background determines the educational path more than intelligence. The golden age of social mobility through education has come to an end (Goldthorpe, 2016), which makes access to university education more difficult for intelligent children from non-academic families, while parents with academic background likely find ways to navigate their children through the educational system widely independent of their cognitive preconditions (Blossfeld et al., 2016). Neglecting the role of intelligence in educational and professional careers not only contradicts the ideals of a meritocratic society, but is also likely to lead to a discrepancy between supply and demand for professional qualifications – with consequences for the functioning of a society. For many – but not all – content areas and career tracks, less intelligence can be compensated for by investing more effort into acquiring the necessary knowledge.

4.2 Beyond mere intelligence scores – roots of cognitive differences

From studies with identical and fraternal twins, it is uncontested that genetic differences can explain a considerable amount of variance in IQ. The correlation between test scores of identical twins raised together approaches $r = .80$ and thereby is almost equal to the reliability coefficient of the respective test. On the other hand, IQ-correlations between raised-together same-sex fraternal twins are rarely higher than .50, a value also found for regular siblings (Stern, 2017). Given that the shared environment for regular siblings is lower than

for fraternal twins, this result qualifies the impact of environmental factors on intelligence. A still widespread misunderstanding is to equate "genetic sources" with "inevitability" because people fail to recognize the existence of reaction norms, a concept invented in 1909 by the German biologist, Richard Woltereck. Reaction norms depict the range of phenotypes a genotype can produce depending on the environment (Woltereck, 1909). The environment regulates gene expression, which means that instead of "nature versus nurture", a more accurate phrase is "nature via nurture" (Ridley, 2003).

The complex interaction between genes and environment can also explain the fact that heritability of intelligence increases during the lifespan (Deary, 2004). This well-established finding is a result of societies in which a broad variety of cognitive activities available in professional and private life enable adults more than children to actively select special environments that fit their genes. People who have found their niche can perfect their competencies by deliberate learning. The amount of variance in intelligence test scores explained by genes is higher the more society members have access to school education, health care, and sufficient nutrition. There is strong evidence for a decrease in the heritability of intelligence for children from families with lower socioeconomic status (SES). For example, lower SES fraternal twins resembled each other more than higher SES ones, indicating a stronger impact of shared environment under the former condition (Tucker-Drob & Bates, 2016). In other words, because of the less stimulating environment in lower SES families, the expression of genes involved in the development of intelligence is likely to be hampered. Although it may be counterintuitive at first, this suggests that a high heritability rate of intelligence in a society is an indicator of economic and educational equity. Additionally, this means that countries that ensure access to nutrition, health care and high-quality education independent of social background enable their members to develop their intelligence according to their genetic potential. This was confirmed by a meta-analysis on interactions between socioeconomic status and heritability rate. While studies run in the United States showed a positive correlation between socioeconomic status and heritability rate, studies from Western Europe countries and Australia with a higher degree of economic and social equality did not (Turkheimer et al., 2003).

4.3 Working memory functions as the source of individual differences

Thanks to the numerous studies on intelligence, we now have a deeper insight into the structure of cognitive abilities. Among the most frequently replicated results is the so-called positive manifold, which means the significant positive correlations between all kinds of subtests measuring reasoning and efficiency

of information processing, no matter whether a verbal, numerical or visual format is used. The shared variance is labelled general intelligence or factor g (Stern, 2017). The interpretation of factor g is still under discussion, and the most promising candidate for factor g is the well-established concept of working memory, which is understood as a mental workspace that is responsible for maintaining incoming information and combining it with already existing knowledge for efficiently approaching a goal (Shipstead et al., 2016). Working memory functions are measured by speed tasks that require goal-oriented active monitoring of incoming information or reactions under interfering and distracting conditions. The success of learning environments such as those provided at school depends on the extent to which they manage to use working memory functions efficiently. This concerns three aspects to be discussed in the following.

First, the efficient construction of knowledge allows to better exploit working memory functions. This has been intensively discussed in section 2 of this paper. If chunked knowledge patterns, automated actions and well-structured conceptual networks can be retrieved from long-term memory, incoming information can be efficiently processed and thereby support further learning. Differences in working memory functions and in reasoning ability can be compensated by well-established prior knowledge in many content areas (Stern, 2017). In other words, learners who do not score at the upper end in cognitive preconditions can acquire a solid level of competence by investing time into efficient knowledge construction. At the same time, we have to acknowledge limits in compensating for less efficient cognitive functioning in terms of working memory and reasoning abilities. More intelligent learners better exploit learning opportunities and achieve higher as long as there is no ceiling effect in the outcome measures (Peteranderl et al., 2023). Also, the complexity of content areas and the abstractness of the concepts in these content areas regulates the requirements placed on intelligence (Berkowitz et al., 2022). University education that deserves its name should place high demands on intelligence.

Secondly, learning environments and learning material should allow to focus on the content and avoid distraction – or extraneous load – as it is formulated in the well-established cognitive load theory from Sweller (2010). Enabling learners to invest their working memory capacity into the content is a core competence of teachers and educational developers. This also includes to make use of the so-called germane load, which implies support learners in acquiring demanding abstract concepts by facing them with challenging learning environments. A research area labelled as "Desirable Difficulties" is evaluating means of instruction which are supposed to prevent learners from jumping to conclusions and making unjustified simplifications.

The third point refers to the development of working memory functions and reasoning ability. People are born very immature, and this is especially true for frontal brain areas that guide working memory functions. Supported by brain imaging techniques as well as by behavioral observation, it is well known that until the age around 3–4, children are completely overwhelmed with simple tasks that require a change of goals. Working memory functions (sometimes labeled as executive functions) improve in the following years steadily and reach their individual maximum only in early adulthood. Particularly during the period of adolescence, youngsters often react when regarding challenged by problems that require the careful planning of actions. Learning environments developed for children and adolescents should take into account that during this age period learners are particularly prone to being distracted and have difficulties with properly structuring actions in complex situations (Steinberg, 2017). Supporting learners in developing planning strategies, for example by giving cues may help them to better exploit learning environments.

5. Perspectives for empirical educational research and implications for practice

In the past decades, considerable progress has been made in better understanding how the human mind works and how motivation can be maintained. Developmental constraints during childhood and early adolescence are now quite well understood, and that also goes for individual differences within age groups. I see two major lines of promising as well as necessary research: 1. Monitoring the role of intelligence in career trajectories as well as attempts to mitigate the dominance of social background; 2. Considering the impact of working memory functions for learning.

Ad 1: On the one hand, we have to do justice to the fact that all people have learning potential and have the right to master competencies necessary for participating in modern societies. On the other hand, for individual and societal benefit, those with above average cognitive competencies should get the opportunity to unfold them from the very beginning. Alternatives to the currently existing tracking systems, which do not do justice to continuous distribution of intelligence, are urgently needed. By developing learning environments and materials that are better adapted to human working memory functions as well as to the differences in these functions may mitigate the challenges in managing diversity. The development and the evaluation of adaptive digital learning tools should be prioritized.

Changing school systems is a long and tedious process, and in Germany several attempts to overcome the disadvantages of tracking were doomed to failure. Future changes need to be better planned. In the meantime, to mitigate the impact of social background on admission to university education, educational sciences should carefully evaluate under what conditions intelligence tests can help to make decisions as fair as possible.

Ad 2: The central role of working memory functions in academic learning from a universal, a developmental, and a differential perspective should determine further research. Thanks to the cognitive load theory, the universal perspective is ready to be implemented in learning material and environments. More research, however, is needed concerning constraints in brain development affecting working memory functions. While early childhood and adolescence got sufficient attention, more has to be learned about the affordances and constraints of working memory among elementary school children in order to optimally exploit their learnability in the first years of school, when the foundations for literacy as well as for mathematical and scientific reasoning are laid.

As discussed above, working memory and reasoning abilities measured in intelligence tests are closely related, but they are not identical. Reasoning abilities need cognitive challenges to develop, facilitated by a well-functioning working memory. While measures of reasoning and working memory show high correlations, there are deviations in both directions. Some individuals with high working memory functions do not fully translate these into reasoning. Others are able to develop reasoning abilities that exceed their working memory functions. Future research should focus on reasons for these patterns as well as consequences for future learning.

Regarding the implications for practice, the fruitful collaboration between learning scientists and subject-specific experts should be continued. Teacher education programs as well as training programs for in-service-teachers should focus on the implementation of proven means for useful knowledge construction in core content areas of their subject. Awareness for the mission of formative assessment and implementing it into daily classroom practice should be a top priority. Understanding what exactly causes students' difficulties can then help to offer the appropriate learning opportunities.

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Florian Schmiedek

Learning for at-risk students

A dynamic perspective

In recent years, there has been growing concern about the socio-emotional well-being and mental health of children and adolescents. These concerns add to the ongoing concerns about the academic achievement of these age groups, particularly with regard to basic competencies, and especially for children from disadvantaged backgrounds. For an education system that not only aims to promote the development of such competencies, but also takes responsibility as an important environment for the identification and prevention of mental health problems and the general improvement of socio-emotional well-being, the question arises as to how these two general domains of outcomes are related. Are they positively intertwined, such that promoting one domain will automatically benefit the other – and failing to do so will increase risk in the other? Or are these outcome domains in conflict, requiring decisions about how to allocate limited educational resources? In what follows, I will argue that attempts to answer these questions at a general level are limited. Rather, the dynamic processes that link learning and well-being and that may place learners at risk for academic failure and mental health problems should be understood as potentially highly individualized and therefore deserving of investigation from a within-person perspective that takes this individuality into account.

1 Students at risk for academic failure and mental health problems

Since the sobering results of the first PISA studies, there has been increased monitoring of the educational system, resulting in worrying figures on the prevalence of students at risk of academic failure. For example, there are the large and increasing percentages of students failing to meet minimum standards in basic competencies as documented by the IQB Bildungstrend (Stanat et al., 2023) and similarly concerning trends in the number of students dropping out of school, as reported in the most recent National Report on Education (Autor:innengruppe Bildungsberichterstattung, 2024). Asking about the risk factors that in turn predict such indicators of academic failure, there is strong empirical evidence for general (background or distal) factors like, for

example, poverty (Selvitopu & Kaya, 2023) and migration background (Heath & Brinbaum, 2014). These contribute to more proximal risk factors at the level of the individual student, like lack of language competences (Snowling et al., 2021), socio-emotional competences (McLeod & Kaiser, 2004), or self-regulation competences (Robson et al., 2020). If the expression of such individual factors is pronounced, it can lead to fulfilling the diagnostic criteria for high-risk categories such as learning disorders or attention deficit hyperactivity disorder (Caviola et al., 2024).

With regard to socio-emotional well-being, there is growing evidence of a disturbingly high and increasing prevalence of mental health problems among children and adolescents. Reports by both international (McGorry et al., 2024) and national expert commissions (Deutsche Akademie der Naturforscher Leopoldina, 2024) have recently reviewed the empirical literature and noticed the magnitude and urgency of the problem. Among the most important risk factors for mental health problems, again background factors such as poverty (Klasen et al., 2017) are prominent. As more proximal factors, familial factors (e.g., mental health problems of parents; Beardslee et al., 2011), experience of violence and abuse (Baldwin et al., 2023), and mobbing (Duffy & Sperry, 2012), for example show relevant roles in predicting mental health problems, which can manifest in diagnoses of mental disorders in the extreme case. In children and adolescents, the disorder categories of depression, anxiety, and psychosomatic problems are particularly prevalent (Deutsche Akademie der Naturforscher Leopoldina, 2024).

In summary, the current numbers and longitudinal trends in both domains, academic achievement vs. failure and socio-emotional well-being vs. mental health problems, are alarming and call for increased political and societal efforts to address and reduce these problems. The fact that important risk factors for both problem domains are partly the same may lead to the expectation that there should be a positive relationship between both problem domains. So, what is the scientific evidence for such an association?

2. The relation of academic achievement and well-being: Theoretical arguments and empirical findings

Regarding theoretical considerations, one can find arguments for, both, a positive ("win-win") relation, as well as a negative ("trade-off") relation between academic achievement and well-being. Arguments for a positive relation often posit positive reciprocal effects between both domains. For example, the *Broaden-and-Build Theory* (Fredrickson, 2001) proposes that well-being can

foster learning processes through a broadening of thought-action repertoires, which can allow to build personal resources that, in turn, enhance well-being. *Self-determination theory* (Ryan & Deci, 2000) also assumes reciprocal relations, with academic success satisfying the need for competence. Being one of the basic psychological needs according to this theory, its satisfaction contributes to well-being. Furthermore, it serves a basis for the development of intrinsic motivation, which in turn is again beneficial for academic performance. Reciprocal effects are also central to *Developmental Cascades Theory* (Moilanen et al., 2010), which posits that externalizing and internalizing symptoms and academic failure can mutually enhance each other.

However, arguments can also be found for a negative relationship between the two domains (see Högberg, 2023, for a summary). The simple fact that time is limited potentially leads to opportunity costs: students who invest a lot of time in learning have less time left for other (e.g., leisure and social) activities that are beneficial for their socio-emotional well-being. In addition, high-achieving contexts (such as elite schools) are often characterized by a competitive climate and a disproportionate emphasis on performance, which can have negative emotional consequences. Given that these different theoretical mechanisms may all contribute to the overall relationship between academic achievement and well-being and thus (partially) counteract each other, it is perhaps not surprising that empirical evidence is mixed and quantitative meta-analytic summaries suggest rather weak relationships. A meta-analysis by Bücker et al. (2018) reports an average correlation of .16 and another one by Kaya and Erdem (2021) results in an average relationship (Fisher's z) of .17. Looking at these numbers alone, one might be tempted to conclude that academic achievement and socio-emotional well-being are relatively independent from each other and therefore could also be addressed by independent measures. In the following, however, I would like to highlight that such an average relation of *between-person differences* may not be informative about the mechanisms that link academic achievement and well-being at the level of individual students, that these mechanisms may in fact be quite heterogeneous across students, and that there is therefore much to be gained by also considering relationships at the level of *within-person variability* by taking a dynamic perspective on the interplay between academic achievement and well-being.

3. The relationship between academic achievement and well-being: Within-person relationships

A central insight that has received increasing attention in psychology in recent decades is that relations observed at the level of between-person differences may not be informative about relations at the level of the individuals underlying these between-person differences. Only under strict conditions (i.e., ergodicity; Molenaar, 2004), inferences from between-person relations to within-person relations are possible. Individuals may differ from each other in their within-person relations and the average within-person relation may differ from the between-person relation. Figure 1 provides an illustrative example. It shows results from the FLUX study (Dirk & Schmiedek, 2016), in which 110 third and fourth graders participated in smartphone-based ambulatory assessments several times a day for up to 31 days. On these occasions, they completed different working memory tasks and several self-report measures, including ratings of task-related enjoyment. The main scatterplot shows the positive relationship between working memory performance and enjoyment averaged over all measurement occasions for each child and indicates a positive relationship (r = .33) – children who perform better on average tend to enjoy working on the tasks more. However, when looking at the level of within-person variation across the different measurement occasions for individual students, the picture can be quite different. In the example, two students (Child 1 and Child 2) with very similar average levels of performance and enjoyment show radically different within-person relationships – for Child 1 this relationship is quite strong (r = .56), for Child 2 there is no systematic relationship at all (r = -.01). Neither one is well characterized by the between-person correlation of .33. Murayama et al. (2017) provide further illustrative examples of heterogeneous within-person relationships in educational psychology research contexts.

Such heterogeneity of within-person relationships suggests that the causal mechanisms producing the observed relationships may also differ across individuals. And even when similar within-person relationships are observed, the underlying causal mechanisms may still be different. Considering the relationship between academic achievement and socio-emotional well-being, there may be achievement-oriented students for whom achievement is a primary source of self-esteem and well-being. For others, their success in learning may be highly dependent on the absence of negative emotions – which would also produce a positive within-person relationship between achievement and well-being, yet based on a different causal mechanism. It may also be the case that an observed positive relationship is produced by third variables that mutually influence both

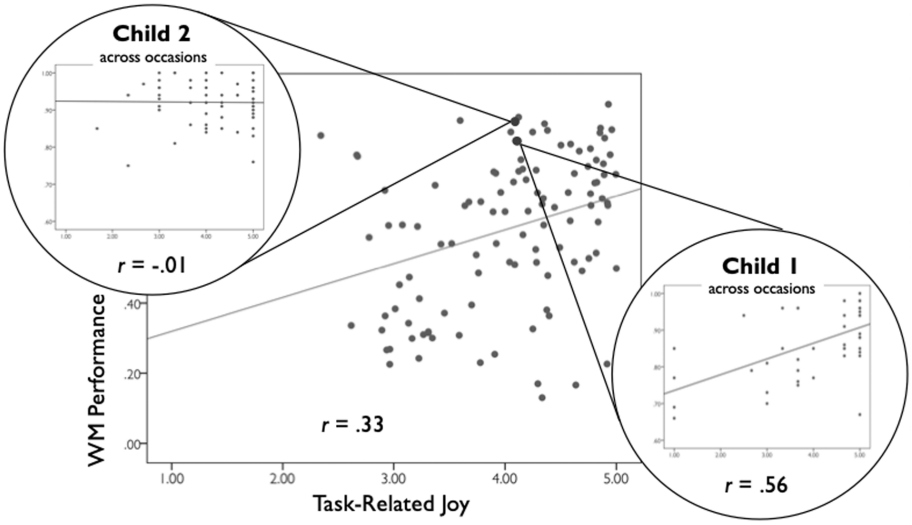

Figure 1. Comparison of the between-person relationship of working memory performance and task-related enjoyment in $N = 110$ children participating in up to 31 days of ambulatory assessment in the FLUX study (Dirk & Schmiedek, 2016) with the within-person relationships of two selected children across study occasions. Working memory (WM) performance is a composite of accuracy on numerical and figural-spatial WM updating tasks with different memory load conditions (see Dirk & Schmiedek, 2016). Task-related joy is a composite of self-rating on the items "*I just had a lot of fun working on the (tasks and) questions overall.*", "*I just enjoyed working on the (tasks and) questions.*", and "*I just found working on the (tasks and) questions boring.*" (reversed item) with 5-point Likert scales.

achievement and well-being, such as day-to-day variations in sleep quality or health status. It is even possible that the relationship may be negative for individual students. Consider a child who performs best at times when parental pressure to perform well is high, which for this child is associated with lower levels of well-being due to stress and test anxiety. Or consider an adolescent who goes through periods of spending a lot of time with peers, which has a positive impact on socio-emotional well-being by meeting the need for social inclusion, but a negative impact on time spent learning. While these examples are speculative, they should serve to illustrate that a weak between-person correlation between achievement and well-being may mask a large heterogeneity of individual relations and underlying causal mechanisms. If known, these different mechanisms would also suggest different individual starting points for interventions aimed at improving achievement and well-being. However, it is only by examining within-person variation with measurement-intensive longitudinal studies that we may be able to identify such between-person variability in relationships and mechanisms.

With the growth of measurement-intensive studies, empirical evidence of such between-person variability is beginning to accumulate in several research areas of psychology, including educational psychology. For example, Niepel et al. (2022) investigated the cross-lagged relationships between mathematical self-concept and perceived mathematics achievement in 372 secondary school students, using self-report measures after each mathematics lesson over a three-week period. They found significant average cross-lagged effects in both directions (i.e., better performance in one lesson predicted better self-concept in the next lesson and vice versa). There were also significant random effects, indicating between-person differences in the strength of these within-person effects. Interestingly, the correlation of these random effects was negative (r = -.56), indicating that the reciprocal effects tended to be stronger in one direction or the other for different groups of students.

Such an indication of potential heterogeneity in within-person relations of constructs related to performance and well-being was also reported by Neubauer et al. (2019). Using data from the FLUX study (see above) and mixture modeling, they were able to identify latent classes with different patterns of relations between working memory performance and four dimensions of momentary affective well-being (positive and negative affect, activation and deactivation). While two of the latent classes showed relatively strong (or weak) within-person relations of performance with all affect dimensions, the other two latent classes were characterized by performance being specifically associated with negative affect and deactivation or exclusively with activation. Again, such heterogeneity may suggest different promising approaches when considering individualized interventions (e.g., reducing negative affect or increasing levels of activation).

4. From bivariate within-person relations to complex dynamic networks

In clinical psychology, research on mental disorders has in recent years increasingly adopted measurement-intensive studies and focused on within-person processes, typically assessed in patients' everyday life contexts using ambulatory assessment (Trull & Ebner-Priemer, 2013). This growth has fostered a parallel new conceptual development based on dynamic systems theory and network modeling approaches (Borsboom, 2017). The general motivation behind this is to move away from the traditional view in psychiatry and clinical psychology, which conceptualizes mental disorders as separate categories that

are characterized by a latent state (e.g., "depression") that manifests in a set of typical symptoms (e.g., lowered self-esteem, loss of interest, suicidal ideation). On the basis of these symptoms, the clinician attempts to make a categorical diagnostic decision about whether a, and if so which, disorder is present, and therapeutic interventions are then based on that diagnosis. The new view abandons the idea that there is a latent disorder state that causes a specific set of symptoms to emerge or increase and instead views individuals as complex systems (Fried, 2022). These can be modeled as multivariate networks of psychological (e.g., mood), physiological (e.g., sleep), and psychopathological symptom (e.g., catastrophic thinking) variables that can influence and interact with each other in complex, dynamic, and potentially highly idiosyncratic ways. Mental disorders arise when such networks, for example through self-reinforcing cycles (e.g., depressed mood → reduced social and physical activity → depressed mood), are driven into unhealthy states from which it is difficult to escape (see next section). The goal of applying these conceptual ideas in research and clinical application is to estimate and understand the networks of individual patients, to use them to reflect on the causal processes that induce and stabilize disordered states, and to identify promising variables to intervene on and break up the malignant dynamics. While applications of dynamic networks typically are rather exploratory in nature (apart from that the selection of variables ought to be driven by theoretical considerations) and take an idiographic perspective, there are also developments towards confirmatory approaches (Du et al., 2025) and towards integrating idiographic and nomothetic perspectives by attempting to group similar individual network structures (e.g., Beltz et al., 2016).

Recently, similar conceptual ideas from dynamic network theory have found their way into educational research. For example, Moeller et al. (2022) have proposed the DYNAMICS framework, which conceptualizes the development of achievement-related motivational and emotional traits as growing out of complex within-person short-term processes of a network of variables that are central to the situated expectancy-value theory (Eccles & Wigfield, 2020). Empirical applications in educational research are still few, with a nice example being a study by Tamura et al. (2022). In this study, daily questionnaires from four participants were analyzed who provided self-reports on a very rich set of 31 components of motivational engagement with regard to their daily work. This set contained motivational reasons, goals, expectancy beliefs, perceived costs, satisfaction of different needs, as well as discrete emotions and global affective experiences, including psychopathological symptom variables (e.g., stress, depression). Based on a total of 595 data points (of four participants combined), a dynamic network of contemporaneous relationships between all variables was

estimated. This resulted in relatively independent clusters of motivational variables on the one hand and emotional and psychopathological symptom variables on the other hand. Although this study was rather exploratory and based on only very few participants, it illustrates how motivational engagement as a central driver of all academic achievement can be examined from a dynamic perspective that takes into account a variety of relevant variables, including those relevant for well-being and mental health. Given the application of dynamic network concepts in both clinical and educational research, consideration could be given to adopting other dynamic systems concepts developed in mental health research and assessing their usefulness for educational research, including concepts of risk and resilience.

5. A dynamic systems perspective on risk and resilience

In the field of mental health research, concepts derived from dynamic systems theory have also been employed to develop novel perspectives on the concepts of risk and resilience. A central concept in this regard is that of attractor landscapes (Heino et al., 2023). These are employed to delineate relatively stable regions within the overall state-space (comprising all potential states) of a system. They have been utilized extensively across diverse scientific disciplines (e.g., ecology) to model the reactions of complex dynamic systems to external influences, their temporal development, and the potential transitions between states that differ markedly from one another (e.g., between rainforest and savanna in tropical regions). When depicted as a two-dimensional topography, these disparate attractors can be conceptualized as valleys. These systems are characterized by the tendency for mild perturbations to produce variability around the equilibrium point, which is located at the bottom of the valley. Only strong perturbations provide the energy necessary to escape the attractor and potentially move into a different one.

The application of these general concepts to mental health research is illustrated in Figure 2, which depicts a simplified case with only one dimension (i.e., negative affect) describing the overall state-space. This space contains two attractor states: one representing affective well-being within the normal healthy range and the other representing depression. Panel A depicts a system that can be described as resilient. Mild perturbations, such as those caused by daily hassles, may elicit emotional reactions that are characterized by some short-term and transient variability. Getting out of the attractor state of such normal well-being and into a depressed state would take a quite strong perturbation, for example, a traumatic life event.

In contrast, Panel B portrays a system at risk. In this scenario, the equilib-

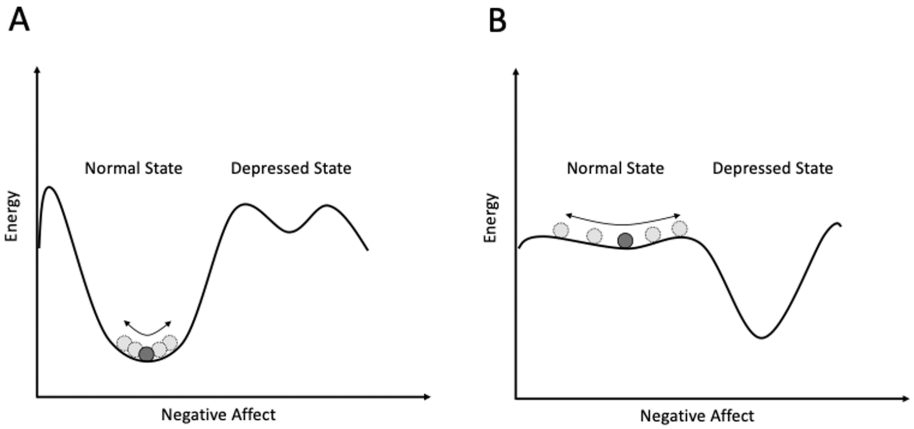

Figure 2. Illustrations of resilient (A) and at-risk (B) states of mental well-being (adapted from Wichers et al., 2015). The solid dark grey points denote systems in local "attractor" or "equilibrium" states. Perturbing the resilient system (A) away from the relatively stable normal state and into the depressed state requires a lot of energy (i.e., a strong perturbation). The at-risk system (B) is in a shallower normal attractor state out of which it can be moved with less energy (i.e., a weaker perturbation).

rium state of normal well-being is less stable and a relatively minor disturbance can result in reaching and passing the tipping point to the attractor state of depression – out of which it is then difficult to escape (e.g., requiring a psychotherapeutic intervention).

These two scenarios can be connected to the concept of dynamic networks introduced above. It can be argued that a resilient state as depicted in Panel A results from a network with rather weak connections between a set of variables (called nodes) relevant for depressive symptomology. Perturbing one node (e.g., experiencing an embarrassing social interaction) may affect other nodes (e.g., lowering self-esteem and motivation for further social interactions) to some degree, but only some and only temporarily. The at-risk state of the system depicted in Panel B may result from the presence of strong temporal connections between the network nodes (Wichers et al., 2015). With such, single perturbations may result in cascading effects and vicious cycles among different symptoms (e.g., sleep and concentration problems) that have reciprocal, unfavorable effects on each other. From a statistical perspective, it has been postulated that networks being in such an at-risk state and moving towards tipping points that may lead to disordered states may exhibit early warning signs, such as increased variance or high autocorrelation (termed "Critical slowing down", van de Leemput et al., 2014). Although the prediction of the onset of episodes of mental disorder based on such warning signs presents methodological challenges and the empirical findings to date are inconclusive (see Helmich et al.,

2024, for a critical review), the conceptual ideas warrant further development and investigation – and should be evaluated for their potential beyond the research domain of mental disorders.

Among the research topics investigated in the field of educational research, one may identify ones in which the existence of substantially different attractor states and the question of how learners change from one into the other are of central interest. This appears to be relatively straightforward for certain expressions of neurodiversity, such as autism and attention-deficit/hyperactivity disorder. These are associated with typical symptoms that can be characterized as attractor states ("meltdown" or "lockdown" states in autism, distracted states in ADHD). Also, in the more general range of learners' behavior there are states seen as beneficial (e.g., the experience of flow) or maladaptive (e.g., procrastination). It is of importance to gain a deeper understanding of how learners become stuck in these states and how they transition in and out of them. Regarding social interactions in the school context, being mobbed may be an example of a state that individual students may get trapped in, due to vicious self-reinforcing cycles of reciprocal interactions. These examples illustrate situations for which it can be argued that complex, dynamic, and idiosyncratic within-person processes must be taken into account. However, there is still little empirical research that attempts to adequately capture these complex phenomena at the within-person level. The aforementioned concepts and their associated methodological innovations may provide promising new avenues for advancing this research.

6. Summary

The individual dynamics of processes related to academic achievement and to socio-emotional well-being may be highly heterogeneous across individuals. For example, individuals may differ in which antecedents for both domains are relevant, in whether these antecedents do overlap, and how they are related to each other. Thus, questions about whether the two domains show trade-offs or reciprocal effects that can lead to virtuous or vicious cycles may have individuum-specific answers. To better understand this heterogeneity, the corresponding multivariate within-person processes need to be studied with intensive longitudinal data. Ideally, such investigation would take place on the individual level. However, if the collection of long time series data necessary for such individuum-specific analyses is out of reach, multilevel approaches with samples of individuals participating in intensive longitudinal data collections with a feasible number of occasions do also allow to capture between-person differences in within-person processes and thus to get closer to the heterogene-

ity of individuals. Concepts from dynamic systems theory can help to understand and model (transitions between) different states and offer new perspectives on risk and resilience – in mental health as well as in learning processes. Ultimately, understanding individual network dynamics could help to identify relevant time points or periods for intervention and the relevant variables to intervene on – thus opening up promising avenues for personalizing interventions.

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Part 2: Emotions, motivation and well-being – the role of socio-emotional aspects in learning

Anne C. Frenzel &Thomas Goetz

Learning and emotions

In this contribution, we set out to take our readers on a journey to better understand the nature of emotions, as well as their antecedents and learning outcomes. The presented emotion theory and existing empirical evidence points to close links between emotions and learning; hence it seems that classrooms designed to optimize students' emotions should also be conducive to effective cognitive development. Nevertheless, we conclude by realizing that it is not trivial to align socio-emotional and cognitive development goals in classrooms. Instead, the typical, performance-oriented classroom settings seem to make those goals operate in competition. By emphasizing mastery-orientation and detaching the roles of "instructor" versus "examiner", a better alignment of the two goals does seem achievable.

But now, into the jungle of human emotional experiences …

1. Emotions in educational contexts: Conceptualization

Emotions function as an "interface between an organism and its environment" (Scherer & Moors, 2019, p. 721), comprising various components such as situational evaluations, action tendencies, physiological responses, expressive behaviors, and subjective feelings. For example, the subjective feeling of pride can arise when an individual has achieved an academic success due to their personal ability or effort. This goes in line with a motivation to engage in similar activities, and is accompanied by physiological changes like increased heart rate and body temperature, as well as expressive behaviors such as smiling, tilting the head back, expanding the chest, and potentially raising arms. In contrast, the subjective feeling of anxiety emerges in face of a potential academic failure, and goes in line with a desire to escape the situation, as well as physiological reactions like a rapid heart rate, sweating, wide eyes, and crouched posture, and worries about negative consequences of the potential academic failure.

Emotions are typically of short duration and directed toward specific objects, setting them apart from moods, which tend to be longer-lasting, less focused on specific objects, and associated with weaker physiological responses and expressions (Coppin & Sander, 2021). The extensive vocabulary around emotions illustrates their diversity and the varying functions emotions can take on.

For example, we can describe how we feel with adjectives like cheerful, elated, confident, joyful, proud, irritated, annoyed, restless, angry, anxious, bored, sad, trepidatious, sorrowful, weary, or dull.

Furthermore, emotions can be conceptualized along a continuum from state to trait (Lazarus, 1994). Emotional states represent momentary responses arising from interactions with the environment, whereas emotional traits reflect the tendency of individuals to experience certain emotions more frequently or intensely over time and situations than others. By definition, emotional traits are relatively stable, as highlighted in research distinguishing state and trait components of achievement emotions (Nett et al., 2017).

1.1 Types of emotions in educational settings

Clearly the best-researched type of emotions experienced in educational contexts are achievement emotions, which emerge during evaluations of one's performance in relation to achievement standards (Pekrun, 2006). One can either achieve those standards – hence, succeed; or not – hence, fail. It is a basic human emotional response to feel positive about success and negative about failure. Examples of discrete achievement emotions include test anxiety, shame, relief, boredom, anger, pride and enjoyment. Educational settings involve extremely frequent and very salient encounters of achievement standards – students are constantly told what they are supposed to accomplish, and provided with feedback as to whether they achieved the proposed standards. Accordingly, they constantly experience successes and failures, which inevitably bring about corresponding positive and negative achievement emotions.

Further, there are also epistemic emotions, such as surprise, curiosity, and confusion. Epistemic emotions do not directly pertain to success and failure in relation to a desired achievement standard, but still involve subjective judgments of one's gaps and changes in knowledge (Pekrun, Vogl, et al., 2017). They arise in contexts requiring engagement with novel or non-routine tasks, such as problem-solving or research projects, as they typically emerge when being confronted with unexpected information or cognitive incongruity. Confusion and frustration are particularly salient epistemic emotions in educational research (Di Leo et al., 2019; Muis et al., 2018).

Another category, topic-related emotions, is triggered directly by the subject matter of learning tasks. Examples include feelings of sadness when learning about political conflicts, or disgust when engaging with certain scientific materials. Lastly, social emotions relate to others' actions or achievements. These emotions encompass admiration, envy, or sympathy, becoming especially relevant in collaborative learning environments (Järvelä, 2012).

In sum, educational settings, and the activity – and duty – of learning involves a rich array of emotions. Clearly, achievement emotions are quite frequent here: The pleasure of success, and pain of failure are pervasive in educational settings. However, learning in terms of expanding and reorganizing one's knowledge base also bears nuanced epistemic emotions, learning topics can arouse emotions in and of themselves, and given that educational settings are typically organized in communities of similarly aged learners, social emotions also accompany learning.

1.2 Appraisal antecedents of achievement emotions

A key theory in educational psychology is Pekrun's Control-Value Theory (CVT; e.g., Pekrun, 2018). This theory is grounded in appraisal perspectives, suggesting that an individual's cognitive assessments of a situation play a crucial role in emotional experiences (Scherer & Moors, 2019). CVT integrates elements from transactional theories of stress-related emotions (Lazarus & Folkman, 1984) and attribution theory concerning emotions (Graham & Taylor, 2014), alongside conceptual overlaps with expectancy-value theories of achievement motivation (Eccles, 2005; Rosenzweig et al., 2019). Initially, CVT concentrated on achievement emotions (see Pekrun, 2024, for a revised version that encompasses multiple groups of emotions). According to CVT, two appraisals are particularly influential in eliciting achievement emotions: subjective control over learning and performance activities and the subjective value of these activities and outcomes. Different discrete emotions form based on distinct patterns of control and value appraisals; for example, enjoyment arises when control is high and success is anticipated, while test anxiety increases when control is low and potential failure is a possibility. Furthermore, control and value appraisals interact, implying that the impact of one appraisal on an emotion can be assumed to depend on the level of the other. For instance, a student taking a low-stakes test (little value) may find that their perceived control (i.e., low confidence in success) has less influence on test anxiety compared to when the test is high-stakes (e.g. crucial for college entry; hence has a high value).

Extensive empirical research supports the links between students' control and value appraisals and a range of achievement emotions. Traditional classroom studies are summarized by Pekrun and Perry (2014), while Loderer et al. (2020) address technology-based learning environments.

1.3 Social-cognitive antecedents of achievement emotions

CVT adopts a social-cognitive perspective, positing that the perceived social environment plays a significant role in shaping students' control and value appraisals, and consequently, their achievement emotions. Pekrun (2018) identifies key aspects of the social environment, including (1) facets of instruction, (2) value induction, (3) autonomy support, (4) goal structures and expectations established by teachers or classrooms, and (5) achievement feedback and its consequences.

Empirical evidence demonstrates correlational and predictive links between these environmental factors and students' emotions, with control and value appraisals serving as mediators. For example, Lazarides and Buchholz (2019) found that students' perceptions of instructional elements like teacher support, cognitive activation, and classroom management were linked to their emotions of enjoyment, anxiety, and anger. Further, Flunger et al. (2019) conducted a field experiment contrasting autonomy-supportive instruction with traditional teacher-centered methods in physics education, revealing that autonomy support—characterized by offering choices and informational language—enhanced positive achievement emotions while reducing negative ones, especially among students with stronger prior performance. In addition, achievement feedback, often conveyed as grades in formal educational settings, significantly impacts students' control and value appraisals regarding their learning activities and subsequently affects their achievement emotions (see Goetz et al., 2018, for a review on feedback and emotions).

Beyond the classroom, family dynamics, peer groups, and broader macro-contexts (such as culturally shaped attitudes towards education) influence students' achievement emotions. For instance, research by Ansong et al. (2017) and Dong et al. (2020) highlight that parents and peers significantly shape values for adolescents in Ghana and China, affecting their engagement, enjoyment, and boredom in school. At a macro-system level, high-stakes testing has been consistently shown to undermine children's well-being (Cho & Chan, 2020).

2. Relevance of emotions for learning and performance

Drawing from basic psychological research on the functions of emotions, it is evident that emotions are linked with learning in many different ways, and hence are linked with performance outcomes. Specifically, the connection between emotions and performance is mediated by various cognitive, self-regulatory, and motivational mechanisms (Pekrun, 2018). There is empirical evidence that negative emotions during learning—such as anger, anxiety, shame,

boredom, and hopelessness—are associated with task-irrelevant thinking, a tendency to use shallow learning strategies (e.g., rehearsal), and less frequent use of metacognitive strategies (Pekrun et al., 2002). Conversely, enjoyment in learning is linked to lower levels of task-irrelevant thinking, enhanced focus, and more effective self-regulation, contributing to deeper and more sustainable learning (Ahmed et al., 2013; Obergriesser & Stoeger, 2020).

Furthermore, substantial empirical evidence exists regarding the relationships between achievement emotions and achievement motivation during the learning process (see Huang, 2011, for a meta-analysis on the links between achievement goals and emotions). Emotions also influence both intrinsic and extrinsic forms of motivation; for instance, positive emotions, particularly enjoyment, are significant drivers of intrinsic motivation (Isen & Reeve, 2005). In contrast, negative emotions like anxiety and anger can lead learners to focus on the task's adverse aspects or the consequences of potential failure, correlating positively with extrinsic motivation or less self-determined types of motivation. It is important to note, however, that research on achievement emotions has rarely been integrated with studies on intrinsic versus extrinsic motivation from a self-determination theory perspective (an exception is Sutter-Brandenberger et al., 2018).

Further, numerous studies have examined direct relationships between achievement emotions and academic performance. Generally, these links are positive for pleasant emotions and negative for unpleasant emotions, as evidenced by multiple meta-analyses including various different discrete achievement emotions, including enjoyment, anger/frustration, boredom, and the most prominent (test) anxiety (Camacho-Morles et al., 2021; Tze et al., 2016; von der Embse et al., 2018). Longitudinal studies have shown that these correlations are often reciprocal, with emotions influencing academic performance and vice versa (Forsblom et al., 2022; Lichtenfeld et al., 2022; Pekrun, Lichtenfeld, et al., 2017; Pekrun et al., 2023).

In summary, there is compelling evidence that emotions significantly influence achievement, while achievement outcomes also affect emotions. There is a complex interplay among emotions, cognitions, motivation, learning behaviors, and achievement, which creates positive and negative cycles.

3. Designing learning environments considering students' emotions

Based on the insights into the antecedents of students' emotions, it is possible to derive implications for how learning environments can be designed so that students experience more positive and less negative emotions. Given the strong connections between students' emotions and their learning and achievement

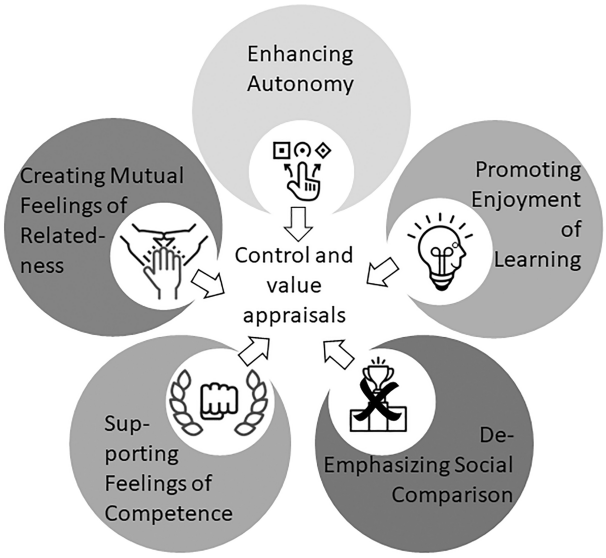

Figure 1. Principles for optimizing students' control and value appraisals to design emotionally healthy learning environments. Abbildung verfügbar unter: 10 . 6084 / m9 . figshare . 30103837, unter CC license (https://creativecommons.org/licenses/by/4.0/)

outcomes, such learning environments should also be conducive to effective learning and optimal achievement outcomes. The following principles outline ways to achieve this, aligning with and expanding upon the "design principles for adaptive motivation and emotion in education" proposed by Linnenbrink-Garcia et al. (2016). A visual summary is depicted in Figure 1.

3.1 Promoting enjoyment of learning

Fostering enjoyment of learning should be a priority to optimize the emotional atmosphere in the classroom. Without resorting to overly entertaining methods, teachers can focus on making topics and learning activities engaging and enjoyable. It is also advisable for teachers to focus on their own enjoyment during teaching, and to remind themselves of what they themselves find fascinating about the lesson content: There is consistent evidence that teachers' own enjoyment and enthusiasm during teaching can transmit to students (Frenzel et al., 2018; Frenzel et al., 2021; Frenzel et al., 2024). Of course, simply creating a joyful classroom atmosphere likely will not suffice to promote learning. However, students' willingness to maintain their attention and to exert mental effort will likely be enhanced when the learning tasks are enjoyable.

3.2 Supporting feelings of competence, enhancing autonomy, and de-emphasizing social comparison

Students are more likely to feel in control of their learning when they perceive themselves as competent. This can be accomplished through well-structured and cognitively clear instruction, along with optimally challenging tasks that are at or slightly above students' current skill levels, facilitating mastery experiences in line with Vygotsky's concept of the zone of proximal development (Vygotsky, 1980).

Fostering autonomy involves providing opportunities for student decision-making and minimizing controlling practices, such as extrinsic rewards or prescriptive instructions about seating and participation (Reeve, 2009). Further, while competition may appeal to some students, a focus on social comparison, such as games with a single winner, creates a perception of success as a limited resource. Similarly, teacher messages that emphasize the significance of exams and potential consequences of failure ("fear appeals") typically only encourage engagement for students who view them as challenges, but undermine motivation for those who perceive them as threats (Putwain et al., 2022). Frequent summative grading also has adverse emotional consequences for learners. Lipnevich et al. (2021) have shown that providing a grade instead of a narrative comment promotes learners' negative emotions, and undermines positive emotions as well as their willingness and quality to revise their work.

3.3 Creating mutual feelings of relatedness

The quality of the teacher-student relationship significantly influences students' engagement and emotional states. High-quality relationships enhance students' interest and reduce negative emotions (Goetz et al., 2021; Quin, 2017; Roorda et al., 2011).

To promote feelings of relatedness, strategies such as spending nondirective one-on-one time with students ("Banking Time") can be effective and beneficial (Driscoll et al., 2011; Pianta et al., 2012). Another approach to enhance the quality of teacher-student relationships is the intervention developed by Gehlbach et al. (2016), which posits that perceptions of mutual similarity between teachers and students (such as endorsing the same food preferences or life mottos) strengthen their bond.

4. Supporting students' emotion regulation

In addition to the deliberations proffered above which ideally lead to increased control and value appraisals and consequently, to students experiencing more positive and less negative emotions in the classroom, it is worth noting that such a hedonistic approach – maximizing positive, minimizing negative emotional experiences – also has its limits. It lies in the human nature to not always feel good. At certain points, negative emotions are unavoidable also in the learning and achievement context: Anyone gets frustrated and stressed when an exam task seems unsolvable, or feels disappointed when a performance outcome falls behind one's expectations. Therefore, it is also important to support students in the regulation of their emotions. To this end, they should be supported in their belief that their emotions are controllable (Ford et al., 2018), and in their acquisition of a broad strategy repertoire to be prepared to regulate their emotions effectively and flexibly (Rottweiler et al., 2023; Stockinger et al., 2025).

5. Learning and emotions – Educational goals in competition?!

The present contribution strives to provide insight into the current state of knowledge how emotions are linked with learning and performance. On first sight, the conclusion from the evidence reviewed in this chapter seems clear and simple. Emotions are strongly and systematically linked with learning and consequently, with achievement: Pleasant emotions emerge from success and promote learning, and negative emotions emerge from failures and undermine learning. Hence, it seems that the promotion of emotional and cognitive development go hand in hand: Enhanced cognitive development results in success, which promotes positive emotions, and vice versa. However, the factual reality at many schools does not seem to be very successful at establishing such positive feedback loops between cognitive development and emotional profit. We propose that one key aspect that undermines the alignment of social-emotional and cognitive development goals is that a majority of teaching settings still seem to involve confronting large and quite heterogeneous learning groups with uniform teaching content and demand levels, and administer highly frequent summative grading, typically involving social comparison standards, hence defining success in terms of outperformance within the social comparison group. Social comparison standards typically imply that within a learning group, a few outstanding grades can be provided, while everyone else receives an average- or below average-feedback. The few students who outperform their peers likely thrive in such environments, but all remaining students rarely experience the emotional pleasure of success. Such displeasure of not being successful in terms

of outperforming others can be alleviated by down-playing the importance of achievement – hence a "don't-care" attitude, which goes along with low effort investment and corresponding compromised cognitive growth.

Consequently, in such contexts where cognitive development and resulting academic performance is equated with outperforming others, the two goals of socio-emotional well-being and cognitive development in fact do clash: Learners seem to have to choose between either downplaying the importance of performance, or striving to outperform others. Both choices bear chances for emotional well-being: Down-valuing the importance of performance protects from the threats involved in failure and implies less effort expenditure; pushing oneself to outperform others bears high promise of the strong emotional reward of being "top." When downplaying the importance of performance and hence investing less effort, learners likely compromise their own potential for cognitive development. When striving for outperforming others through excessive effort expenditure, this may be conducive to learners' cognitive development. However, striving to outperform others also constantly bears the risk of not managing to stay "top", hence involving a considerable degree of avoidance motivation. Furthermore, if the comparison group is weak, outperforming others may in fact come easily, thus compromising the full potential cognitive development of some individuals, specifically those with a high cognitive potential.

To resolve this and better align emotional and cognitive development goals, we propose that educators shift the definition of success to learning in the sense of intraindividual growth or mastery of absolute (rather than social) comparison standards. With social comparison standards, success becomes scarce (also only one or very few individuals can be the best) and uncontrollable (as typically individuals do not get to choose or have control over the social comparison group they are placed into). While classsroom goals involving individual growth and mastery or absolute comparison standards also do not guarantee success, the individual's efficacy in achieving success for everyone, along those standards is considerably higher. As a result, all learners are provided with more or less the same chances of success, the investment of effort better pays off for learners at all levels of cognitive potential, and opportunities for experiencing success and the corresponding emotional pleasure would be more frequent for a larger proportion of learners (see also Dweck & Yeager, 2019, for similar ideas from a more cognitive perspective). Another tangible policy which may support the alignment of students' socio-emotional and cognitive development might lie in the detachment of the "instructing" and the "grading" role for teachers – again especially if grading is very much about summative rank-ordering learners according to their achievement (rather than formative assessment about the individual student's current skill level). The classical role of the teacher involves

both quite inseparably, presenting the learning materials and at the same time designing and grading tests. This implies that that students constantly feel they are tested, with corresponding adverse emotional consequences in terms of potential failure. Teachers, in turn, seem to get caught up in seeing students in terms of their rank within the learning group, and lose sight of how each individual student can best be supported in advancing their individual cognitive development. By detaching the instructing from the grading role of the teacher, and clearly differentiating between instructor-provided formative feedback and externally administered summative grading, we propose that students' socio-emotional and cognitive development could be better aligned in classrooms.

In conclusion, a better understanding of how emotions are linked with learning and performance bears important insights for optimally designing learning environments, and for best supporting learners in both their cognitive and their social-emotional development. Asking "how do you feel" is always a question worth asking – in and out of learning and teaching contexts.

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Well-being and learning

Taking inclusive education as a prominent example

1. Introduction

Over the last two decades, student well-being has increasingly moved into the spotlight of educational research. An examination of the rapidly growing body of literature reveals that student well-being is considered both particularly relevant for academic functioning and as a favourable educational outcome in itself (Steinmayr et al., 2018; Suldo et al., 2011). It is widely assumed that well-being and learning are intricately linked. On the one hand, students' school-related well-being serves as an indicator of the quality of a learning environment, which facilitates positive learning processes. On the other hand, it is generally expected that successful learning fosters students' well-being (Hascher, 2012). Similar assumptions apply to the context of inclusive education, where students' well-being is recognised not only as a key indicator of the quality of inclusion but also as an aim of inclusive education (Powell & Hadjar, 2018; Venetz, 2015; Wächter et al., 2024).

Nonetheless, a recent systematic review regarding the association between well-being and academic achievement of school-aged children has uncovered inconsistencies in findings, ranging from positive associations to no association or contradictory results (Amholt et al., 2020). Conflicting results are also reported regarding students' well-being in relation to inclusive education (Dalgaard et al., 2022; Goldan et al., 2022). Furthermore, several studies have demonstrated a general decline in subjective well-being from childhood to adolescence (Bücker et al., 2023; Casas & González-Carrasco, 2019), and from primary to lower secondary education (Knickenberg & Zurbriggen, 2021; Obermeier et al., 2022). These apparent contradictions raise the question of a possible trade-off between fostering students' well-being and promoting academic learning and achievement (Clarke, 2020).

Against this backdrop, this chapter aims first to briefly elucidate the concept of student well-being and its measurement, and second, to provide concise insights into the state of research concerning the associations between students'

subjective well-being and academic achievement, as well as on relevant factors of the learning environment within a classroom. Additionally, exemplary findings on students' subjective well-being in relation to inclusive education are presented, followed by a (preliminary) conclusion and suggestions for future directions.

2. Focus on students' subjective well-being

2.1 Conceptualising well-being

Since well-being is a broad, multifaceted construct (Tov, 2018), it may explain inconsistencies in findings regarding the association of students' well-being and academic achievement. Corresponding to an umbrella term, which is frequently used interchangeably with other terms (e.g., happiness, mental health, life satisfaction) and applied in many different contexts, well-being is often viewed as an ambiguous concept (Joos et al., 2018).

The variety of terms or definitions describing well-being can be broadly grouped into objective and subjective aspects or dimensions of well-being (Voukelatou et al., 2021). While *objective* well-being reflects people's material living conditions and their observable quality of life – including aspects such as physical health, safety, environment, and academic achievement – *subjective* well-being captures people's own perceptions or evaluations of their overall quality of life or of specific domains or situations.

Empirical educational research has mainly focused on students' *subjective* well-being. The most widely acknowledged conception of subjective well-being is the one by Ed Diener (Schimmack, 2008). According to Diener (1984), subjective well-being consists of the reflective cognitive judgements people make about their life in general or in specific domains (e.g., work, school, family), as well as positive and negative emotional responses to ongoing life experiences or specific situations (Diener et al., 2018).

2.2 Measuring students' subjective well-being in school

When conceptualising subjective well-being, it is essential to not only differentiate between *components* (i.e., cognitive, affective) and *life domains* (i.e., general, domain-specific), but also between *time frames* as in the general state-trait model (Eid, 2008). Accordingly, the framework model for the measurement of subjective well-being by Lischetzke and Eid (2006) distinguishes between habitual and momentary or situation-specific subjective well-being.

This distinction is also important when measuring students' subjective well-being in school. One prominent example of subjective well-being as a *trait* is the conception by Hascher (2010). She defined students' subjective well-being in school as a multicomponent construct that includes positive attitudes towards school, enjoyment in school, the absence of worries about school, a positive academic self-concept, and the absence of social problems as well as physical complaints in school. Measuring students' subjective well-being as a *state* primarily concerns its affective component, or more specifically, positive and negative affective experience in specific (learning) situations. Affective experience or state-like emotions can be assessed via momentary data techniques such as the experience sampling method (ESM; Hektner et al., 2007), which allows to capture state characteristics in situ and in real-time.

In educational studies, researchers have typically relied on retrospective self-reports when measuring students' subjective well-being. However, such memory-based reports of emotional aspects are often over- or underestimated (Conner & Barrett, 2012). To investigate retrospection effects of students' emotional experience in the classroom and possible changes during early adolescence, we compared retrospectively assessed affective experience (i.e., positive and negative activation) with in situ via ESM reported affective experience (Zurbriggen et al., 2021). Our findings indicated to a positive recall bias (i.e., 'rosy view') of students' affective experience at the end of primary education and to a negative shift in recall bias (i.e., 'blue view') by the end of lower secondary education.

3. Subjective well-being, academic achievement, and the learning environment

While about twenty years ago researchers had to make a plea for the relevance of well-being in school (Fend & Sandmeier, 2004), it is nowadays generally assumed that students' subjective well-being reflects a school environment that facilitates learning processes and promotes students' academic achievement. Successful learning, in turn, is thought to be essential for experiencing satisfaction and positive emotions in school (Hascher & Hagenauer, 2011). Thus, subjective well-being is viewed as a predictor of students' engagement and motivation to learn (Hascher, 2012). Since school and the classroom are also sources of negative experiences (e.g., academic failure, rejection by peers), subjective well-being can also serve a preventive function.

3.1 Associations of subjective well-being with academic achievement and engagement

Based on such theoretical considerations, several studies have examined the relationship between students' subjective well-being and academic achievement. The first meta-analysis on this topic showed a positive, but only small correlation (r = 0.164) between academic achievement and subjective well-being (Bücker et al., 2018). The correlation was stable across various levels of demographic variables, different components, and domains of subjective well-being, as well as across different contents and alternative measures of academic achievement. The authors concluded that high-achieving students do not necessarily report high subjective well-being, and low-achieving students do not automatically report low subjective well-being.

As students' engagement has been described as an important strength leading to well-being and positive learning outcomes, Wong and colleagues (2024) investigated in their recent meta-analysis the associations of students' academic engagement with subjective well-being and academic achievement. Their meta-analysis revealed medium correlations between students' engagement and subjective well-being, being most closely related to affective engagement (r = .40), followed by cognitive (r = .35) and behavioural (r = .31) engagement. The average correlation of engagement with subjective well-being (r = .35) was similar to the one with academic achievement (r = .33).

3.2 Factors of the learning environment affecting subjective well-being

Although the classroom is considered the most influential school context both on students' subjective well-being and their learning (Hascher, 2012), empirical evidence supporting these theoretical assumptions is still scarce. However, several studies have explored the impact of certain aspects of the learning environment within a classroom on students' subjective well-being. A large part of these aspects corresponds to social characteristics of the learning environment, but also a teacher's instructional practice plays a decisive role in developing and fostering students' well-being.

Social factors within a classroom that positively affect students' subjective well-being include positive relationships with peers and peer support (Goswami, 2012; Hoferichter et al., 2021), a positive student-teacher relationship (Zheng, 2022), and a supportive classroom climate (Oberle, 2018; Zurbriggen, Hofmann, et al., 2023). Factors that negatively affect students' subjective well-being include peer bullying, (strong) competition among peers (Arslan et al., 2021; Hoferichter & Raufelder, 2017), conflicts with teachers,

and pressure from teachers to achieve (Kiuru et al., 2020; Stang-Rabrig et al., 2023).

Regarding teachers' instructional practices, recent studies have shown that differentiated instruction is positively related to students' subjective well-being (Pozas et al., 2021) and that good instructional quality has a positive impact on students' subjective well-being (Obermeier et al., 2022).

4. Inclusive education and students' subjective well-being

Most of the aforementioned factors positively affecting students' subjective well-being and learning correspond to crucial characteristics for the successful implementation of inclusive education. Inclusive education not only means access to general education but also providing high-quality teaching and learning environments that maximise the academic and social-emotional development of all students (United Nations [UN], 2006, Art. 26). Differentiated instruction is seen as a vehicle to achieve inclusive education (Pozas et al., 2021) by implementing, for instance, adequately adapted teaching practices tailored to students' needs (Gheyssens et al., 2023).

As already mentioned, students' subjective well-being is considered an important indication of the quality of inclusive education. Simultaneously, it also serves as a useful indicator for adaptive teaching, as it affects a teacher's decisions on how to design classroom interventions and instructions (Praetorius et al., 2015). Thus, accurate teacher judgement of students' subjective well-being is an important condition for adaptive teaching, which in turn promotes each student's learning and academic development.

In the following, exemplary findings of our own studies on the topic of inclusive education and subjective well-being are briefly presented.

4.1 Students' emotional experience and adaptive teaching

The first research question relates to the affective component of subjective well-being as a state: How do students experience different classroom situations of adaptive teaching in inclusive education? To address this question, we conducted an experience sampling study in 40 classrooms of Grades 5 and 6 in Switzerland (primary education) with about 720 students and a total of over 8000 occasions (Zurbriggen & Venetz, 2018). The results of our multilevel multigroup analyses showed that the included characteristics of adaptive teaching had a similar positive effect on students' emotional experience. When students had the option to choose between tasks, they were generally more positively activated (e.g., more energetic) and less negatively activated (e.g.,

less stressed) than when they could not choose between tasks. Similarly, the students were more positively activated and less negatively activated when they were able to work with their peers and did not have to work alone. Furthermore, students' emotional experience was best when the perceived difficulty level of a task was slightly higher than average. However, one differential effect between student groups was observed: The group of students with above-average academic achievement and well-adjusted social behaviour only reached maximum positive activation for tasks that they experienced as significantly more difficult than average.

4.2 Teacher judgement accuracy of students' subjective well-being in inclusive education

Second, we investigated teachers' judgement accuracy of students' subjective well-being as a trait and whether the (in-)accuracy in teacher reports (i.e., specificity) could be explained by student and teacher characteristics. To address these questions, we drew from the self-reports of about 2600 students in Grade 6 and the corresponding ratings of about 430 homeroom teachers and applied a multiple-indicator correlated trait-correlated method minus one model with explanatory variables (Zurbriggen, Nusser, et al., 2023). Following the conception by Hascher (2010), we focused on three components: emotional well-being in school, social inclusion in class, and academic self-concept. To investigate factors explaining the specificity in teacher reports of students' subjective well-being, we accounted for selected characteristics relevant in the context of inclusive education and adaptive teaching.

Our findings showed that teachers' judgement accuracy of students' subjective well-being was only low to moderate. 12 % of the variance in teacher reports of students' emotional well-being was shared with the students' self-reports and 18 % with regard to social inclusion, while for the academic self-concept the consistency was a little higher at 33 %.

In terms of student characteristics, the status of special educational needs (SEN), gender, and academic achievement were significantly related to the specificity in teacher reports of all three aspects of students' subjective well-being. The effects were most pronounced for academic achievement, particularly on the academic self-concept. German as a primary vs. secondary language could only explain the specificity in teacher reports of the academic self-concept. The teacher characteristics included could explain the specificity in teacher reports only to a small extent. While teaching experience was negatively, but only very weakly, associated with the specificity in teacher reports of the students' academic self-concept, teachers' self-efficacy, their attitudes

towards inclusion, and their responsibility for every student were positively associated with the specificity in teacher reports of students' emotional well-being and their social inclusion in class.

4.3 Development of students' subjective well-being in lower secondary education

The third and last research question relates to the development of students' subjective well-being in inclusive classrooms during lower secondary education and whether students' academic achievement can predict changes in their subjective well-being.

To this end, we draw on data from the longitudinal project *Inclusive Education in Lower Secondary Schools in Germany* (INSIDE). The sample consisted of about 4600 students from lower secondary education who participated in Grades 6, 7, and 9. We specified a latent neighbour change model with predictors for change in subjective well-being. As expected, the findings showed that students' emotional well-being and their social inclusion slightly decreased from Grade 6 to Grade 9. The academic self-concept remained relatively stable. Furthermore, peer-related classroom climate and student-teacher relationship could predict change in students' subjective well-being.

5. Conclusion and future directions

This leads back to the initial question of this chapter: whether there is a trade-off between well-being and learning. Rather than being incompatible goals, research suggests that their relationship is not straightforward and that several gaps need to be addressed (Clarke, 2020). To reach a more solid conclusion about the assumed reciprocal relationship between students' subjective well-being and academic achievement or other learning outcomes, more longitudinal studies are required (Bücker et al., 2018).

Future studies would benefit from including potential moderating or mediating variables at the individual, classroom, and school levels, such as personality, instructional strategies, or school climate (Steinmayr et al., 2018). For instance, it could be worthwhile to investigate the role of students' engagement in this regard, as students' subjective well-being seems to be more strongly associated with academic engagement than with academic achievement.

Our findings indicate that adaptive teaching has a positive impact on students' emotional experience (Zurbriggen & Venetz, 2018). The question remains whether adaptive teaching has medium- and long-term effects on students' subjective well-being as well as on successful learning. Additional re-

search differentiating between components and time frames of subjective well-being could provide important insights into specific effects and underlying processes.

In light of the relatively low accuracy of teacher judgement regarding students' subjective well-being (Zurbriggen, Nusser et al., 2023), there is a risk of unjustly accusing teachers or placing additional pressure on these already heavily burdened professionals. Given the complexity and difficulty of estimating subjective or internal constructs, the discrepancies between the self-reports and teacher ratings of students' subjective well-being could be just used as diagnostic information. Being aware of student's own view and possible bias may reduce the expectancy effects of under- or overestimation, for instance, of students with SEN or low achievement. Interventions regarding inclusion have the potential to change teachers' beliefs, particularly if they provide the opportunity to gain experience with inclusive practices (Dignath et al., 2022).

As for further practical implications, creating a supportive social classroom climate can enhance students' subjective well-being, but also positively affect learning processes and achievement. This could be undertaken by incorporating elements and strategies of 'positive education' (Seligman et al., 2009), or by implementing evidence-based, systemic social and emotional learning (Rimm-Kaufman et al., 2023). In this vein, teachers should be supported in their endeavours in fostering a rich learning environment where all students can thrive academically and enhance their subjective well-being.

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Ricarda Steinmayr

Learning and motivation

Which motivation is important and how to foster it

Both laypersons and experts widely regard motivation as a key determinant of academic performance, seeing it as both a prerequisite and an educational goal in its own right (Spinath, 2022). In a world characterized by rapid change, sustained motivation to acquire new knowledge is essential for active participation in society. Furthermore, motivation is thought to be relatively amenable to influence, making it a potentially powerful lever in educational settings. This raises an important empirical question: Does the commonly held belief in the importance of motivation for academic achievement hold up under scientific scrutiny?

1. The power of motivation in explaining interindividual differences in academic achievement

In academic literature, motivation refers to the entirety of processes that govern the initiation, direction, and intensity of behavior. It encompasses both internal states (such as needs or goals) and external influences that drive or guide behavior (Heckhausen & Heckhausen, 2018). Empirical evidence supports a relationship between motivation and academic achievement. Meta-analyses consistently demonstrate positive associations between these constructs (e.g., Cerasoli et al., 2014; Howard et al., 2021; Wirthwein et al., 2013). However, it is crucial to note that "motivation" is an umbrella term that encompasses a variety of constructs (for a detailed overview see Spinath, 2022). These constructs are typically categorized into three main groups: goal orientations, achievement motives, and expectancy-value variables (Elliot & Church, 1997; Murphy & Alexander, 2000; Pintrich et al., 2003). Of these, constructs within the expectancy-value category—such as ability self-concepts, self-efficacy, interest, and intrinsic motivation—show the strongest correlations with academic achievement, with medium to high effect sizes (Cerasoli et al., 2014; Howard et al., 2021; Möller et al., 2009; Multon et al., 1991; Schiefele et al., 1993; Stajkovic et al., 2018; Steinmayr et al., 2018). Achievement motives, generally conceptu-

alized as trait-like dispositions subdivided into "hope for success" and "fear of failure" are also associated with academic performance (Bjørnebekk et al., 2013; Steinmayr et al., 2019b; Steinmayr & Spinath, 2009). Hope for success correlates positively with academic outcomes, while fear of failure shows a negative correlation. Goal orientations, however, tend to exhibit only small correlations with academic achievement; specifically, work-avoidance goals are negatively associated with performance (particularly in mathematics), whereas approach-performance and learning goals have small positive correlations with achievement (Noordzij et al., 2021; van Yperen et al., 2015; Wirthwein et al., 2013). Figure 1 illustrates the varying correlations between different motivational constructs and academic achievement.

While these findings indicate that motivational constructs share a meaningful proportion of variance with academic performance, bivariate correlations alone provide an incomplete picture. Motivation is related to other powerful predictors such as intelligence (Bergold & Steinmayr, 2016) and personality (Steinmayr et al., 2011). These are also related to academic outcomes and the associations are sometimes even stronger (see Roth et al., 2015, for a meta-analysis on the association between intelligence and grades). Thus, some researchers even argue that motivation lacks predictive power for academic achievement beyond what is explained by intelligence (e.g. Gagné & St Père, 2002). Consequently, establishing the importance of motivation for academic success requires demonstrating its incremental validity—namely, the extent to which motivation contributes to the explanation of academic performance over and above other key predictors.

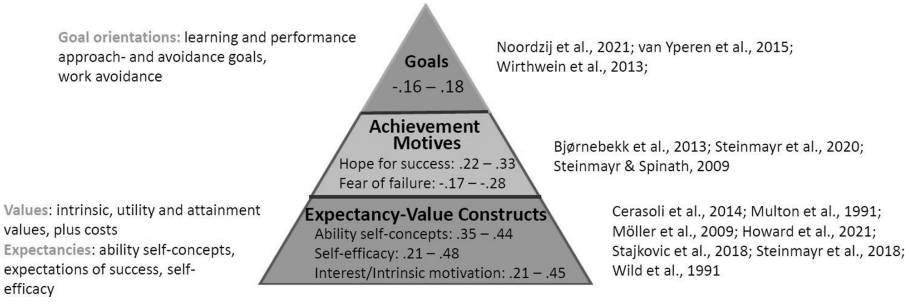

Figure 1: Correlations between different motivational constructs and academic achievement (goals: Noordzij et al., 2021; van Yperen et al., 2015; Wirthwein et al., 2013; achievement motives: Bjørnebekk et al., 2013; Steinmayr et al., 2019b; Steinmayr & Spinath, 2009; expectancy-value constructs: Cerasoli et al., 2014; Howard et al., 2021; Möller et al., 2009; Multon et al., 1991; Schiefele et al., 1993; Stajkovic et al., 2018; Steinmayr et al., 2018). Goals pertain to learning goals, performance-avoidance and -approach goals and work avoidance.

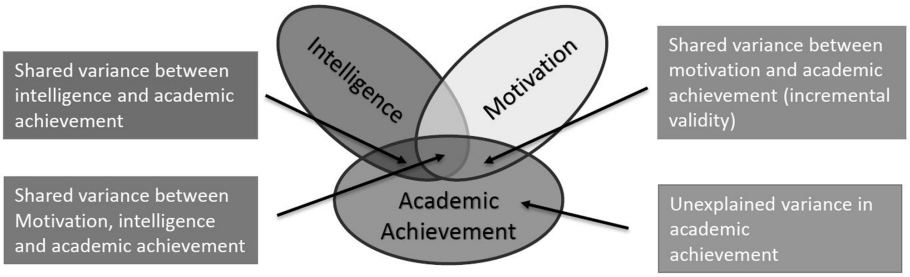

Figure 2: Graphical illustration of the incremental validity of motivation in predicting academic achievement above and beyond intelligence.

Figure 2 illustrates this critical concept in understanding the role of motivation in academic performance. As depicted, some variance in academic achievement is unaccounted for by both constructs. Some variance in academic achievement is only explained by interindividual differences in intelligence, some only by interindividual differences in motivation and some by both. In several studies, we explored the incremental validity of motivation beyond intelligence, personality, or a combination of both when predicting academic achievement (Lauermann et al., 2020; Steinmayr & Spinath, 2007, 2009; Steinmayr et al., 2011, 2018, 2019; Steinmayr & Meißner, 2013). One such study (Steinmayr & Spinath, 2009) exemplifies this relationship. Figure 3 displays the main results.

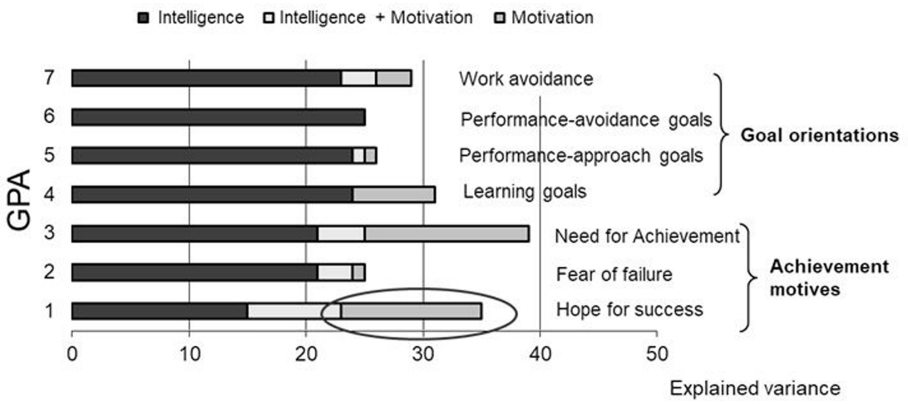

Figure 3: Graphical illustration of the commonality analysis results performed by Steinmayr and Spinath (2009).

In Figure 3, the medium grey portions of the bars in the results represent the unique variance in academic achievement attributed to motivation alone, even

after controlling for intelligence. Similar findings have been observed when controlling for personality alone or both intelligence and personality (Steinmayr & Spinath, 2007; Steinmayr et al., 2011). In all studies motivation accounted for variance in academic achievement which was not accounted for by the other constructs. As indicated by the light grey portions of the bars, some motivational constructs predict academic achievement in conjunction with intelligence. This shared variance—particularly strong for the construct "hope for success" in the displayed study—suggests an interaction effect between intelligence and achievement motives. Supporting this, other studies (Bergold & Steinmayr, 2018; Hufer-Thamm et al., 2023) demonstrated that intelligence was positively related to school grades only when accompanied by a certain level of achievement motivation, highlighting an interplay between these constructs in predicting academic success.

Besides its incremental validity in explaining variance in academic achievement, the importance of motivation is also underlined by its power to explain change in academic achievement. When asked about their child's academic struggles, many parents attribute it to a lack of motivation, believing that renewed motivation could lead to improved performance. Research supports this perception (see Lesperance et al., 2022). Across several studies, motivational constructs have been shown to predict changes in academic achievement, measured by both school grades and standardized achievement tests (Steinmayr et al., 2018, 2019; Steinmayr & Spinath, 2009). This is particularly noteworthy given that individual differences in academic performance tend to stabilize over time, limiting the potential for change. Remarkably, the effect of motivational constructs on changes in academic achievement was up to four times greater than the effect of intelligence, underscoring motivation's critical role in fostering academic growth (Steinmayr et al., 2019b; Steinmayr & Spinath, 2009).

2. Evaluating the relative importance of motivational constructs in academic achievement

Given the diverse array of motivational constructs it is crucial to empirically identify which are most predictive of academic success. Since the specific characteristics of a sample can influence the observed correlations, it is advisable to examine multiple motivational constructs within a single sample to rule out the possibility that differences in correlations are attributable to the sample's characteristics. Furthermore, expectancy-value constructs are often domain-specifically operationalized, while achievement motives are generally treated as more stable, trait-like characteristics assessed in a broader context. Since contextual-

ization affects the association between constructs (cf. Michel et al., 2022), it is essential to assess both motivational constructs and achievement outcomes at equivalent levels of specificity. To ensure the generalizability of findings across academic domains, it is also recommended to cross-validate results in multiple areas. Another challenge in motivational research is multicollinearity among constructs. Certain constructs, such as ability self-concepts, self-efficacy, and expectations for success, often overlap to the extent that they are nearly indistinguishable empirically (e.g., Marsh et al., 2019). Similarly, intrinsic values, intrinsic motivation, and interest are also closely related to each other but also to expectancy variables. Appropriate statistical techniques, such as commonality analysis and relative weight analysis, are therefore necessary to disentangle the specific contributions of these constructs (for specifics on relative weight analysis see Johnson & LeBreton, 2004; Tonidandel & LeBreton, 2011). Last but not least, to develop effective educational policies and implement meaningful school reforms, it is essential to gather strong empirical evidence on whether different motivational constructs can account for variations in school performance beyond the effects of other important variables, such as intelligence and prior achievement. Excluding these latter factors risks overstating the role of motivation in academic success.

Taking into account these thoughts, Steinmayr et al. (2019) sought to address these methodological considerations by examining various motivational constructs alongside prior performance and intelligence, with all variables assessed at comparable levels of specificity. We evaluated constructs from expectancy-value theory, including values and ability self-concepts, as well as achievement motives (hope for success and fear of failure), achievement goals (learning-approach, performance-approach, performance-avoidance), and work avoidance. Each variable was measured across different academic domains (general academic ability, math, and German), enabling cross-validation across subject areas and ensuring consistent specificity levels. A relative weight analysis, which quantifies the relative importance of each predictor in explaining variance in a criterion (LeBreton & Tonidandel, 2008), was employed due to the high intercorrelations among motivational constructs. The relative weight ε can be interpreted as an indicator of the relative importance of each motivational construct compared to other predictors and its thought to represent the share of explained variance in the specific grade by this specific motivational construct. In the study by Steinmayr et al. (2019), prior math grades emerged as the most significant predictor of subsequent math grades (explaining 45 % of the unique variance), followed by math self-concept (19 %). Students' math task values (9 %), learning goals (5 %), work avoidance (7 %), fear of failure, and hope for success (6 %) did not significantly differ in their contributions. Notably,

performance goals and intelligence did not significantly predict achievement when analyzed alongside prior grades. Similar patterns were observed for overall school achievement and language arts grades. Here again, among all motivational variables ability self-concepts and values were the strongest predictors (for more details see Steinmayr et al., 2019b). In a similar study, considering further variables such as grit – the consistency of interests and persistence in the pursuit of long-term goals (Duckworth et al., 2007) – and personality – operationalized as the Big Five of personality (Costa & McCrae, 1995) – Steinmayr et al. (2018) also found expectancy-value variables to be strongest predictors of academic achievement among all considered motivational variables. However, in both studies, expectancy-variables were more strongly associated with academic achievement than value variables. These findings held regardless of whether prior performance and intelligence were controlled (see also Steinmayr & Spinath, 2009; Steinmayr et al., 2011, 2018). Thus, regarding the question of which motivational constructs are particularly influential in shaping academic performance these studies demonstrated that domain-specific ability self-concepts, especially in math, are critical predictors of academic achievement. However, when it comes to achievement-related choices—such as vocational or academic pathways—values, particularly intrinsic values, become as significant as ability self-concepts (Steinmayr & Spinath, 2010). Consequently, in the following discussion, I will focus on expectancy-value constructs, which are both central to academic achievement-related criteria.

3. How to foster ideal expectancies and values

Before fostering expectancy constructs, it is essential to first determine the desired level of development. The question whether individuals should strive for a realistic or an optimistically biased self-view has especially been discussed with regard to ability self-concepts. Unlike intrinsic motivation, which is broadly beneficial if it is high, the optimal self-concept is less straightforward. Should one aim for a self-perception that aligns with actual abilities, or is a positively biased (overestimated) self-view more advantageous? If so, shall I overestimate myself just a little or greatly? The results of empirical research on self-estimation biases and academic performance are mixed, with some studies finding positive effects and others finding negative ones. These inconsistencies may arise from theoretical and statistical issues that often confound self-estimation bias with self-view effects (Humberg et al., 2018, 2019). Recent work by Paschke et al. (2020, 2023) clarifies that positively viewing one's competencies—irrespective of actual ability levels—can have a favorable impact on academic achievement.

If a positive self-concept (and intrinsic motivation) is beneficial, what fosters such an outlook? Several models explain the development of ability self-concepts across different domains, including the I/E model (Marsh, 1986), the big-fish-little-pond effect (e.g. Marsh et al., 2004), and the situated expectancy-value model (e.g. Eccles & Wigfield, 2020). According to the latter model, socializers' beliefs and behaviors—particularly those of teachers (cf. Steinmayr et al., 2019a)—affect students' self-concepts, which are empirically equivalent to expectations of success, and also values. However, the practical significance of teacher expectancy effects on students' development has occasionally been questioned due to their relatively small size (Jussim, 2017; Jussim & Harber, 2005). But most studies have concentrated on school performance, thus, this critique may overlook the possibility that teacher expectations influence numerous other important aspects of students' lives beyond academic achievement, for example ability self-concepts and values, as hypothesized by the situated expectancy-value model. The study by Bergold and Steinmayr (2023) investigated how teachers' expectations regarding students' abilities impact various student outcomes, including expectancy-value constructs. The longitudinal study involved 1,092 ninth-grade students from vocational track schools in Germany. Students completed assessments of their math and reading competencies, ability self-concepts, intrinsic motivation, academic and vocational aspirations, and subjective well-being. Teachers rated students' abilities in math and German using a seven-point scale based on national performance distributions. Our analysis revealed unique effects of math teachers' expectations on students' change in math performance, ability self-concepts, and educational aspirations. Though the effect of math teachers' expectations on intrinsic motivation was marginally insignificant ($p = .07$), intrinsic motivation at baseline predicted changes in math performance. German but not math teachers' expectancies affected students' life satisfaction. Teacher judgments thus affect many student outcomes at the same time, among them expectancy-value constructs, underscoring their practical importance for students' lives. Furthermore, they seem to be more important for expectancies than for intrinsic values. Thus, the question remains which variables additionally contribute to change of value variables.

The situated expectancy-value model (Eccles & Wigfield, 2020) does not only explain differences in intrinsic values but also in other values such as utility or attainment values and costs. Recently there has been a lot of research on interventions, especially minimal interventions to change values but also expectancies especially of disadvantaged groups (cf. Rosenzweig et al., 2020, 2022). Moreover, there is also increased interest in domain-specific beliefs about the nature of abilities, following research in implicit intelligence theories / mindsets.

Implicit beliefs about the nature of intelligence—whether viewed as fixed or malleable—are also pertinent to understanding motivational dynamics. Mindsets refer to an individual's subjective beliefs about whether specific attributes, such as intelligence or mathematical ability, are unchangeable or can be developed and improved (e.g., Dweck & Yeager, 2019). The belief that an attribute is fixed represents a fixed mindset, while the belief that it can be cultivated reflects a growth mindset. Unlike a fixed mindset, a growth mindset is theorized to enhance students' motivation and academic performance, especially among those facing challenges. Research indicates that when teachers view intelligence as unchangeable, their behavior tends to be more achievement-oriented, focusing on performance outcomes rather than the learning process (e.g., LaCosse et al., 2021; Park et al., 2016). However, such performance-oriented behavior has been linked to lower levels of student motivation, as it may create a high-pressure environment that prioritizes results over effort and improvement (e.g., Ames, 1992; Wirthwein et al., 2021). Furthermore, the nature of the learning environment significantly influences the way success is perceived and pursued. In achievement-oriented learning environments, the emphasis is on demonstrating one's competencies, with success often being defined in comparison to the accomplishments of peers (Ciani et al., 2010; Dweck & Leggett, 1988). This focus on relative performance strengthens the association between individual success and external validation. In contrast, learning-oriented environments prioritize the process of acquiring knowledge and improving personal competencies in those environments, success is measured by individual growth and mastery, leading to a weaker association with external comparisons or peer-relative outcomes (Dweck & Leggett, 1988; Meece et al., 2006). The self-determination theory explains individual differences in intrinsic motivation, among others, by different feeling of competences. Thus, in a learning-oriented environment, even students who receive performance feedback (in Germany mostly operationalized by grades) suggesting they are not performing as well as their peers can remain intrinsically motivated. Here, irrespective of a students' performance level, all students have the possibility to increase their competencies and thus perceive themselves as successful and competent learners which should weaken the association between grades and intrinsic values. In contrast, in a performance-oriented environment, only students outperforming their peer might be motivated which should strengthen the association between performance feedback and intrinsic motivation.

Following these rationales, Heyder et al. (2020) investigated whether math-specific implicit intelligence beliefs affected the association between students' intrinsic motivation and performance feedback (grades) in math in a large sample of German fourth graders and their 56 teachers. Findings revealed that

teachers were more likely to attribute success in math to innate ability compared to German language arts. Furthermore, the stronger a teacher held a belief in the necessity of innate ability for math success, the lower the intrinsic motivation of their low-achieving students. These results highlight that teachers' perceptions of math as requiring innate ability may hinder the creation of a classroom environment that promotes intrinsic motivation for all students and might be especially detrimental for low-achieving students.

These are just a few examples of factors that might influence expectancy-value variables. Beyond interventions and socializers' beliefs, numerous other factors impact these variables, including cultural norms, classroom characteristics, teaching styles, teacher attributes, environmental factors, and more (see Baumert et al., 2002; Eccles & Wigfield, 2020; Kunter et al., 2013). Recent research has focused on students' perceptions of socializers' beliefs (e.g., Reschke et al., 2023) and classroom characteristics (Wirthwein et al., 2021). Understanding the interplay between objective characteristics, students' perceptions of them, the factors influencing those perceptions, and their impact on key motivational constructs such as expectancy-value variables will significantly enhance our understanding of motivation.

4. Conclusion on the importance of motivation

Among the various motivational variables, expectations and values stand out as significant predictors of interindividual differences in career aspirations, academic achievement, and its progression over time (Nishen et al., 2024; Steinmayr & Spinath, 2009, 2010; Steinmayr et al., 2018, 2019). Thus, motivation holds considerable potential to enhance achievement-related outcomes across STEM fields and other domains. Importantly, it can be influenced by external factors beyond the individual, such as teachers' beliefs about ability, which can be modified to a certain extent. However, the role of motivation in academic achievement should not be overstated, as academic achievement is influenced by numerous factors as outlined by several models explaining interindividual differences in academic achievement (e.g., Eccles & Wigfield, 2020; Baumert et al., 2002, p. 16). Some of these factors are very hard to change and are thus relatively stable, such as social and educational family background, while others are more flexible, including the quality of teaching, for example due to a teacher change. Additionally, some factors interact with motivation, such as aptitude (Bergold & Steinmayr, 2018), while others are unrelated. Academic achievement is a highly complex phenomenon that cannot be fully explained by a single variable or even a set of related variables like motivation. This complexity underscores the need for a multidimensional approach to understanding

and fostering academic achievement which should consider motivation and its interplay with further achievement-related variables.

Furthermore, quite a lot of open questions remain concerning the role of motivation for academic achievement as motivation is a complex construct influenced by a variety of factors spanning individual, contextual, cultural, and biological domains. Recent research highlights the reciprocal effects between teacher characteristics and student motivation, emphasizing the dynamic interplay between educators' attitudes, behaviors, and students' motivational development (Kriegbaum et al., 2019). These findings underscore the importance of teacher-student interactions in shaping long-term educational outcomes. The effectiveness of motivational strategies and interventions has also garnered considerable attention, particularly regarding their sustainability over time. Minimal interventions, which require relatively low investment of time and resources, have been shown to yield significant benefits in certain contexts (Harackiewicz et al., 2023). However, understanding their long-term impact on student motivation and achievement is critical for informing evidence-based practices in education. Cultural differences further complicate the landscape of motivation. Cultural norms, values, and beliefs can shape motivational processes, influencing how individuals perceive success, effort, and failure (e.g., Chirkov et al., 2003; Heine et al., 2001). These variations highlight the necessity of culturally responsive motivational strategies to support diverse student populations which has rarely been investigated. On a more fundamental level, biological and neurophysiological foundations of motivation provide insights into the underlying mechanisms driving motivational behaviors. Advances in neuroscience have revealed how brain structures, neurotransmitter systems, and hormonal processes interact to influence motivation and goal-directed actions (Di Domenico & Ryan, 2017; Morris et al., 2022). However, there is still a need for a deeper understanding of how these biological and neurophysiological factors combine to produce unique motivational patterns, taking into account personal, environmental, and cultural influences. While significant progress has been made in identifying general mechanisms, much remains to be explored regarding their nuanced interplay and real-world applications. Another factor that needs more research is emotion. Motivation is also intricately linked with emotions. Emotional states can significantly enhance or undermine motivational processes, shaping individuals' goals (Chamani et al., 2023; Järvenoja et al., 2018), and performance in various activities. However, the process underlying these relations are not fully understood. The interplay between motivation and emotions is thus a critical area for further investigation. Lastly, sources of individual differences in motivation extend beyond frameworks like the situated expectancy-value model (Eccles & Wigfield, 2020). Factors such as

personality traits, prior experiences, and social influences contribute to these differences, underscoring the need for a more integrative understanding of the factors shaping motivation. By exploring these diverse dimensions, researchers and practitioners can develop more holistic approaches to fostering motivation in educational and other settings. Given its importance for academic achievement, the endeavor is worthwhile.

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