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THE POWER OF STUDENT ATTITUDES:

THE IMPACT OF EMOTIONAL AND SOCIAL FACTORS ON ACADEMIC ACHIEVEMENT

SERIES #2

Lessons from TIMSS 2023

Foreword

Modern educational research clearly emphasizes that a student's academic achievement is determined by the interplay of various factors. For example, empirical evidence accumulated over the past decades indicates that student performance depends not only on how the learning process is organized and the quality of instruction, but also on the student's internal state, expectations, emotions, belief in their own abilities, and attitudes toward school. The results of TIMSS 2023 also highlight the complex nature of academic achievement in the context of learning and teaching mathematics and science.

"The Power of Student Attitudes" is a significant part of the national report on the TIMSS study. It reflects how a student's emotional and social environment (such as sense of school belonging, self-efficacy, bullying, emotions, and values) influences academic achievement—and, in turn, the future. This series aims to analyze how the student's inner world and socio-emotional state affect learning outcomes in mathematics and science. At the same time, it serves as a call to action—for education policymakers, school communities, teachers, and parents—to recognize learning as a multilayered process grounded in emotion, social context, and values.

Structure of the Series: Each chapter of the series is dedicated to a specific psychosocial factor: sense of school belonging, self-efficacy, bullying, academic emotions, and student values. These factors are analyzed as part of the complex mechanisms that shape student engagement, motivation, and success in the learning process. The analysis focuses both on the impact of these factors on academic outcomes and on the underlying drivers, including the socio-pedagogical context and their dynamics.

The concluding section of the series presents recommendations that serve as a practical guide for schools. These recommendations are intended for those who wish to develop a learning environment where students not only acquire knowledge but also build confidence, motivation, and a healthy attitude toward learning.

We hope that in addition to sharing insights from TIMSS findings, this series will raise important questions and offer inspiration to help turn schools into safe spaces—places where students believe in their own potential, want to learn, and view education as a path to both professional and personal development. This series presents research-based recommendations, that will help schools create a more inclusive, empathetic, student-centered, and effective learning environment.

The report was prepared by the National Center for Educational Research

განათლების, მეცნიერებისა და
ახალგაზრდობის სამინისტრო

Content

Graphs and illustrations

1. School Belonging

Scholl as a second family:

Why Is a Student's Emotional Connection to School Important?

The sense of school belonging refers to students' feelings of attachment to their school, and their perception of being accepted and valued by peers and school staff (Willms, 2000). In other words, school belonging is a student's feeling that they are respected, supported, accepted on a personal level, appreciated, and given the opportunity to participate in meaningful matters at school (Anderman, 2002; Knifsend & Graham, 2012; Ma, 2003; Nichols, 2006).

The feeling of belonging has been a central topic of research in psychology, sociology, and education. The prominent 20th-century psychologist Maslow (1943; 1954) included the need for belonging in his hierarchy of five fundamental human needs (physiological needs; safety needs; belongingness needs; esteem needs; and self-actualization needs). According to Maslow, it is important for individuals to perceive themselves as valued members of the environments in which they spend a significant amount of time and to feel accepted, recognized, and emotionally supported by those around them. The sense of belonging is a fundamental psychological need that has a significant impact on a student's emotional well-being as well as academic success. Research shows that school belonging is associated with lower levels of student stress (Newman et al., 2007), higher self-esteem, better mood (Begen & Turner-Cobb, 2015; Newman, Lohman, & Newman, 2007), improved memory (Haslam et al., 2010), and increased engagement in goal-oriented activities (Baumeister & Leary, 1995). Moreover, according to self-determination theory (Deci & Ryan, 1985), belonging is considered one of the most important factors of intrinsic academic motivation. When this fundamental need for belonging is not met, it becomes difficult for students to succeed academically (Glasser, 1986). Therefore, strengthening the sense of belonging is critically important for creating a learning environment that fosters each student's development and academic success.

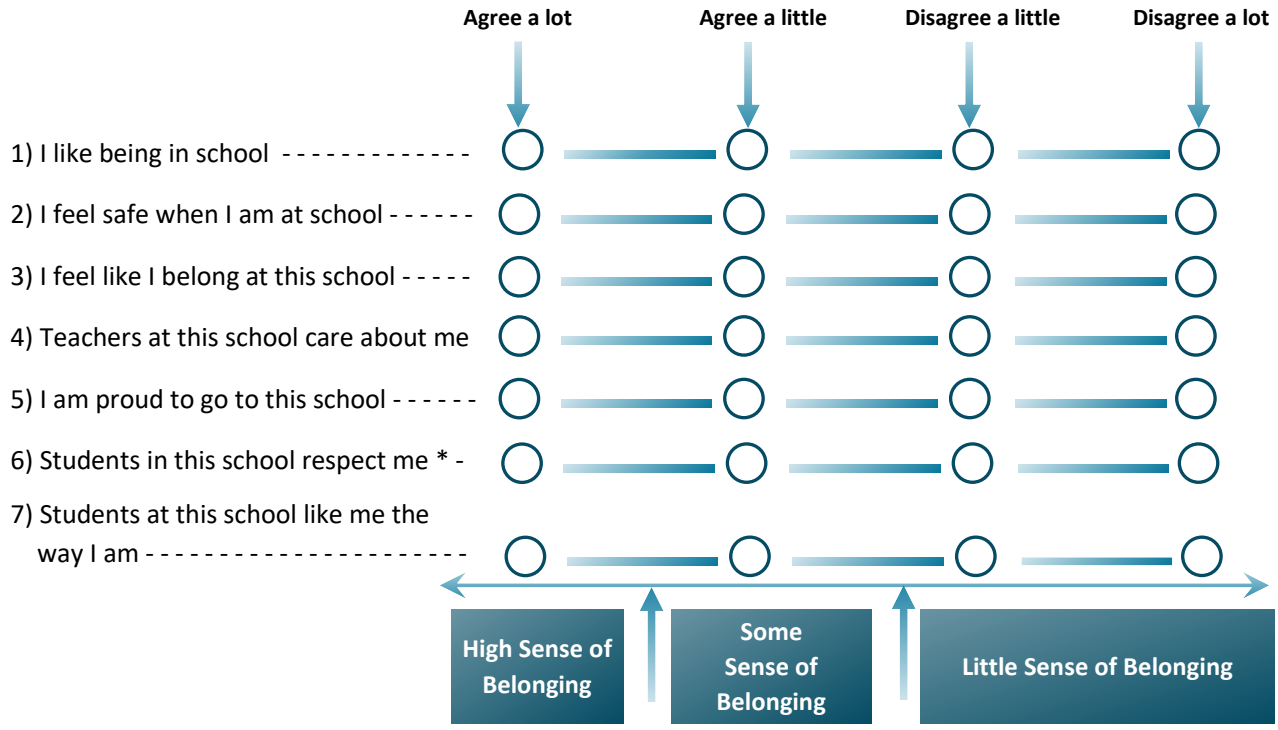
School Belonging and Academic Achievement

Given the importance of school belonging, it is only natural that scholars and education professionals prioritize studying both the relationship between belonging and academic achievement, and the factors that influence students' sense of belonging. Numerous empirical studies demonstrate the positive effects of school belonging on academic success. One such study is a meta-analysis by Korpershoek et al. (2019), which found that the stronger the students' sense of belonging at school, the better their academic performance, motivation, and engagement in activities. In turn, when students experience meaningful, positive relationships at school (Baumeister & Leary, 1995) and feel cared for, appreciated, and emotionally supported by school staff, their motivation to learn increases, along with their chances of academic success (Goodenow, 1993).

Insert: *How Is Students' Sense of School Belonging Assessed in TIMSS 2023?*

Illustration 1. Statements1 from the Sense of School Belonging Scale

What do you think about your school? Tell how much you agree with these statements.



* Item not included in scale at the fourth grade

The Power of Connection to School – How the Sense of Belonging Affects Students' Academic Achievement According to TIMSS 2023

According to the 2023 TIMSS study findings:

- The higher the level of school belonging, the higher the achievement of 4th and 8th grade students in both mathematics and science (see Table 1 and Table 2).
- The sense of belonging to school is stronger in the 4th grade than in the 8th grade. The decline in students' sense of belonging with age may be explained by several factors, such as: the increasing formalization of the school environment at the lower secondary level, growing individualism, transformations in the nature of social relationships, and/or psychosocial processes characteristic of adolescence.

[1] School Belonging scale is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **High Sense of Belonging, Some Sense of Belonging, and Little Sense of Belonging**.

It is also noteworthy that, compared to the international average, **Georgia has a higher proportion of students with a high Sense of school belonging.** This may indicate that the school climate and environment in Georgian schools contribute to fostering a strong sense of belonging — which can be considered a strength of Georgia's school education system.

Table 1. Students' Sense of School Belonging and Mathematics Achievement

	High Sense of Belonging		Some Sense of Belonging		Little Sense of Belonging	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	75% (1.1)	506 (2.9)	21% (1.0)	492 (5.4)	4% (0.4)	485 (9.4)
Grade 8	40% (1.3)	471 (5.1)	45% (0.9)	472 (3.1)	15% (0.8)	462 (4.8)
TIMSS International results						
Grade 4	57% (0.1)	511 (0.5)	30% (0.1)	502 (0.5)	12% (0.1)	486 (0.8)
Grade 8	30% (0.1)	484 (0.7)	49% (0.1)	478 (0.6)	21% (0.1)	461 (0.8)

Table 2. Students' Sense of School Belonging and Science Achievement

	High Sense of Belonging		Some Sense of Belonging		Little Sense of Belonging	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	75% (1.1)	474 (3.3)	21% (1.0)	458 (4.7)	4% (0.4)	448 (11.9)
Grade 8	40% (1.3)	452 (4.4)	45% (0.9)	452 (2.9)	15% (0.8)	448 (4.5)
TIMSS International results						
Grade 4	57% (0.1)	502 (0.5)	30% (0.1)	493 (0.6)	12% (0.1)	478 (0.8)
Grade 8	30% (0.1)	480 (0.7)	49% (0.1)	477 (0.6)	21% (0.1)	463 (0.9)

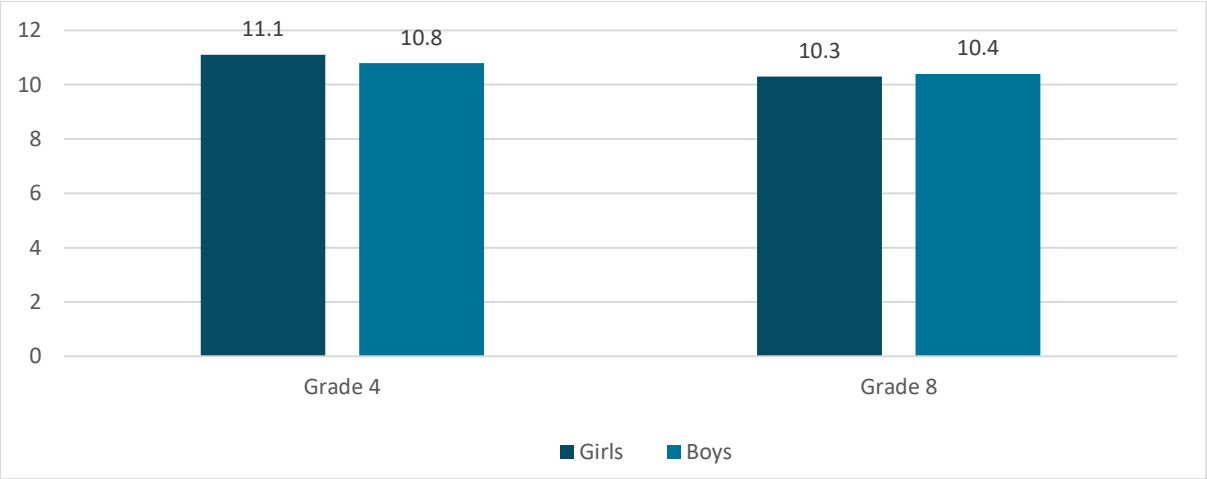
Gender Differences – Is there a difference in the sense of school belonging between girls and boys?

Research shows that girls tend to have more positive attitudes toward school and a higher sense of school belonging than boys (Nichols & Good, 1998). Scholars have attributed this difference to girls' generally stronger socialization skills (Galambos, 2004), which may contribute to their higher levels of school belonging (Hughes et al., 2015).

An analysis of TIMSS 2023 data supports this finding: in primary school (Grade 4), girls ($M = 11.1$, $SD = 1.7$) typically report a higher sense of school belonging than boys ($M = 10.8$, $SD = 1.9$). This difference is statistically significant ($t(42736) = 18.9$, $p < 0.001$). However, as students grow older (Grade 8), the overall level of Sense of School Belonging declines, and the gender gap becomes statistically insignificant. This finding highlights the dynamic nature of Sense of School Belonging throughout the

school years and underscores the importance of strengthening school-based interventions—especially during adolescence—to help sustain students' sense of belonging.

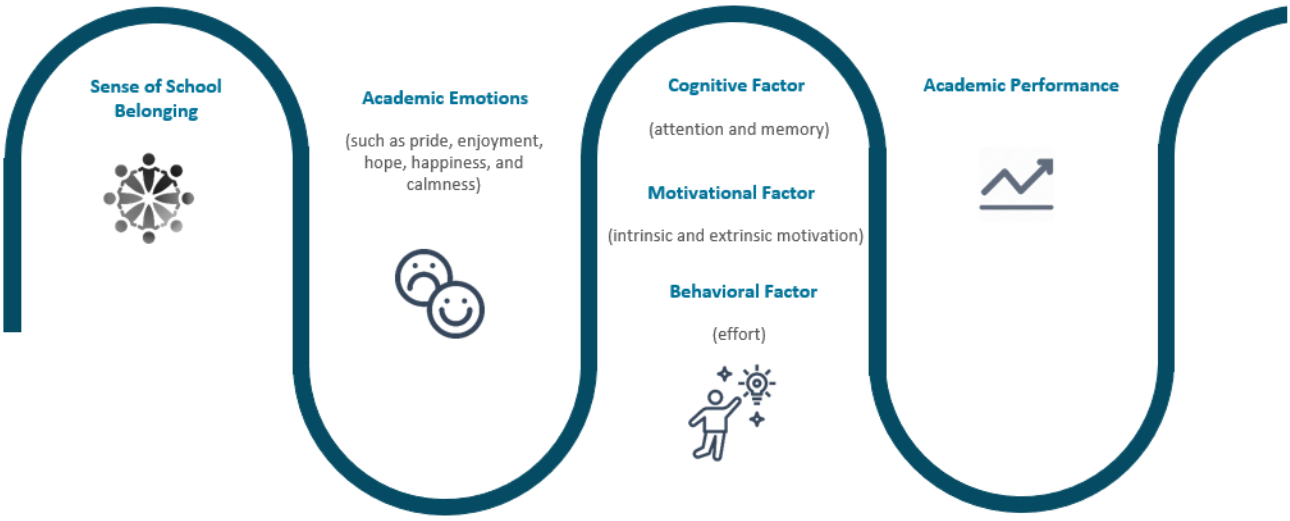
Illustration 2. Gender Differences in School Belonging



The Impact of School Belonging on Academic Emotions and Attitudes

Research shows that the relationship between school belonging and academic achievement is mediated by academic emotions. Specifically, the higher a student's sense of belonging to school, the more positive emotions they experience—such as pride, enjoyment, hope, happiness, and calmness—which, in turn, positively affect academic performance (Chen et al., 2015). According to researchers, school belonging enhances students' emotional stability and their ability to relax and enjoy learning, which contributes to better academic outcomes.

Positive academic emotions also influence various aspects of academic engagement, including cognitive (attention and memory), motivational (intrinsic and extrinsic motivation), and behavioral (effort) factors (Pekrun & Linnenbrink-Garcia, 2012). In summary, **Sense of School Belonging is a fundamental "ingredient" in fostering positive academic emotions**, making it a key predictor of students' academic success.



According to TIMSS 2023, a strong sense of school belonging is associated with academic emotions such as positive attitudes (liking) toward mathematics and science subjects, as well as a sense of self-efficacy (confidence) in these subjects. The study's findings show a clear link between students' feelings of school belonging and their attitudes toward mathematics and science in Grade 4.

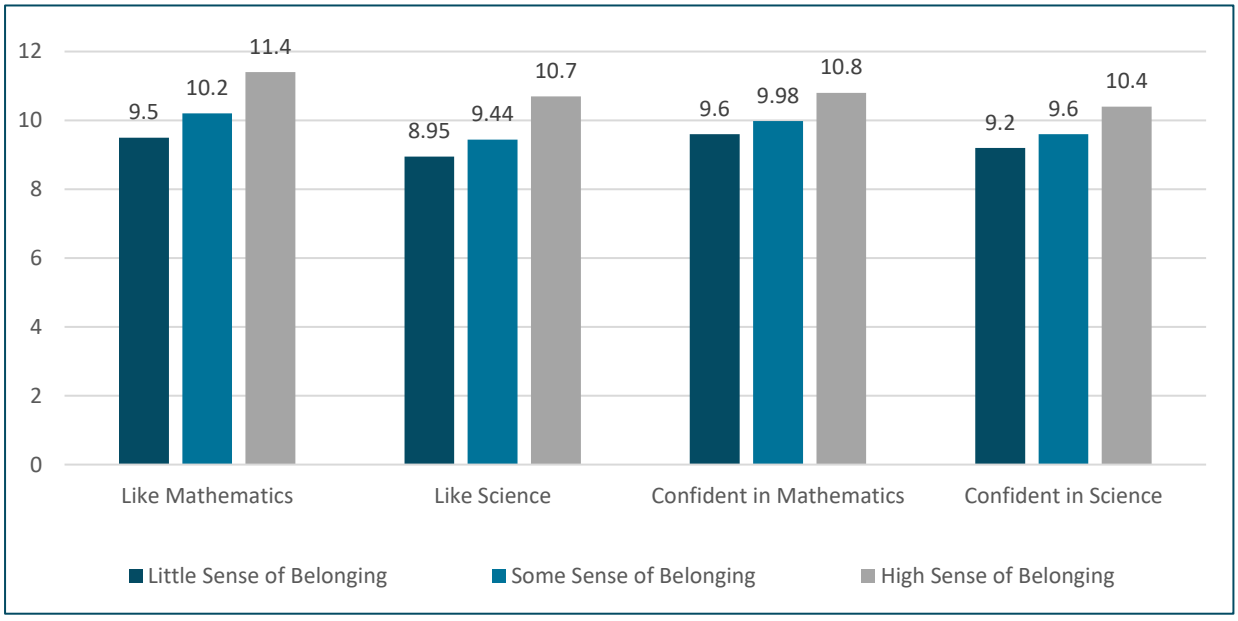
More specifically, students with a strong Sense of School Belonging:

- Enjoy learning mathematics and science more.
- Feel more confident and have greater belief in their own abilities.

Statistical analysis confirms that in both Grade 4 and Grade 8, there are statistically significant differences ($p < 0.001$) in students' average levels of confidence and enjoyment in these subjects across all levels of school belonging (*High Sense of Belonging, Some Sense of Belonging, Little Sense of Belonging*).

These findings align with other research suggesting that when students feel "at home" in their school environment—where they are loved, accepted, and supported—this positively influences their academic emotions. In particular, when students feel a strong sense of belonging to their school, they show greater interest and, consequently, more engagement in the learning process. Moreover, a strong sense of belonging strengthens their confidence and belief in their own potential.

Illustration 3. Sense of School Belonging and Academic Emotions (Grade 4)



This finding once again highlights that a strong sense of school belonging and a school environment where students feel safe and perceive themselves as part of a "family" are essential preconditions for the development of positive emotions toward academic subjects. Accordingly, educational strategies that strengthen students' sense of belonging to their school may serve as important tools for enhancing their academic motivation and confidence/self-efficacy.

What Factors Influence Students' Sense of School Belonging?

The results of TIMSS 2023 clearly show that the **teacher's work** has the greatest impact on students' sense of school belonging. Specifically, this relates to how clearly and structured teachers explain material during mathematics and science lessons—an aspect TIMSS refers to as "**Instructional Clarity**."

It was found that:

- **Instructional clarity** in mathematics and science lessons significantly predicts students' emotional connection to school. This highlights the teacher's role not only in delivering subject knowledge but also in shaping students' psychosocial well-being. **When instruction is clear and structured, it enhances student engagement, reduces confusion and stress, and fosters a stronger sense of belonging to the school environment.**
- Compared to **Instructional Clarity, school safety and students' readiness to learn** have much weaker effects on school belonging. This suggests that ensuring a safe environment alone is not enough to strengthen students' sense of belonging.
- Interestingly, the **School's Emphasis on Academic Success** does not enhance students' feelings of belonging (its effect on school belonging is statistically insignificant). This may indicate that students associate the learning process more with their teachers and their classroom experiences than with the school's formal academic demands.

Thus, TIMSS 2023 findings suggest that **teachers' professionalism, communication skills, and effective teaching practices** are key to fostering an emotional connection between students and school. These factors lay the foundation for a strong sense of school belonging.

These findings are based on the results of multifactor regression analisis, which are described indetail in the appendix.

What Do Other Studies Say About This?

Numerous studies (Goodenow, 1993; Arends & Visser, 2015; Ulmanen et al., 2016; Bouchard & Berg, 2017) confirm that **positive student-teacher relationships** have a strong effect on school belonging: the better students' attitudes toward their teachers, the higher their sense of belonging and their achievement in mathematics. Generally, when students feel that teachers are caring, supportive, and warm, school becomes a safe and nurturing environment that enhances student engagement and achievement. One possible explanation for the gender gap in school belonging is that **girls, on average, have more positive attitudes toward teachers than boys** (Korpershoek et al., 2019).

Another key predictor of school belonging is **teacher empathy**. According to research by Maloney & Matthews (2020), students feel the strongest sense of belonging in math classes and school overall when they perceive their math teacher as empathetic, caring, and supportive. Conversely, students who do not perceive emotional support, empathy, or respect from their teachers tend to feel less connected to school. Additionally, students with a high sense of belonging are more likely to value mathematics as a subject and enjoy solving math problems.

Insert: Multivariate Regression Analysis

Grade 4

Predictors: School Emphasis on Academic Success, Safe and Orderly School environment, Instructional Clarity in Mathematics and Science Lessons, Classroom Teaching Limited by Students Not Ready for Instruction.

Dependent variable: Sense of School Belonging

Model summary: The overall regression model was statistically significant, $F(5,5076) = 217.7$, $p < 0.001$, indicating that the listed variables collectively provide a significant prediction of students' sense of school belonging. The model explained 17.6% of the variance in students' feelings of school belonging.

Regression coefficients: The strongest predictors of school belonging were the clarity of instruction in mathematics (ß = 0.31, $p < 0.001$) and science lessons (ß = 0.21, $p < 0.001$), both of which reflect factors related to teachers' competence and instructional skills. The Safe and Orderly School environment (ß = 0.03, $p = 0.02$) and Classroom Teaching Limited by Students Not Ready for Instruction (ß = 0.03, $p = 0.02$) were also statistically significant, but had relatively weaker effects. Interestingly, the School Emphasis on Academic Success was not a statistically significant predictor (ß = −0.01, $p = 0.61$), suggesting that focusing solely on academic achievement does not enhance students' sense of school belonging.

Similar patterns were observed in the **Grade 8** data: The most influential factor in shaping students' Sense of School Belonging was again Instructional Clarity, particularly the relationship between Students' Sense of Belonging and the Instructional Clarity in Mathematics Lessons (ß = 0.43, $p < 0.001$).

2. Self-efficacy

The Power of Self-Efficacy:

How a Student's Belief Shapes Their Success

The concept of self-efficacy was introduced by Albert Bandura (1977). According to his definition, self-efficacy is the collection of beliefs and perceptions individuals hold about their own abilities, which **influence how they set goals, cope with challenges, and achieve success**. It is important to emphasize that self-efficacy is not an objective measure of a person's skills or capabilities, but rather a subjective perception. In other words, a person may possess the necessary skills for a specific task but still believe they are incapable of performing it—or vice versa. "What people think, believe, and feel affects how they behave" (Bandura, 1986, p. 5). Beliefs about oneself and one's abilities are essential for predicting behavior. For example, individuals tend to avoid situations or actions they believe they are not suited for.

According to Bandura (1986, 1997), beliefs related to self-efficacy—*how strongly people believe in their own competence and skills*—are among the most significant beliefs individuals can hold. These beliefs influence career choices, the amount of effort people invest, and their perseverance in the face of challenges. In academic literature, perceived self-efficacy—an individual's belief that they can successfully complete a specific task—is viewed as a key determinant of knowledge acquisition (Ale et al., 2017; Schunk & Pajares, 2007).

Self-Efficacy and Academic Achievement

The importance of self-efficacy is especially evident in academic contexts, where students are frequently required to overcome difficulties and acquire new knowledge. Research shows that students with high self-efficacy are more likely to engage in solving complex problems, demonstrate active self-regulation, and apply problem-solving strategies. They tend to view challenges positively, whereas students with low self-efficacy often see obstacles as insurmountable.

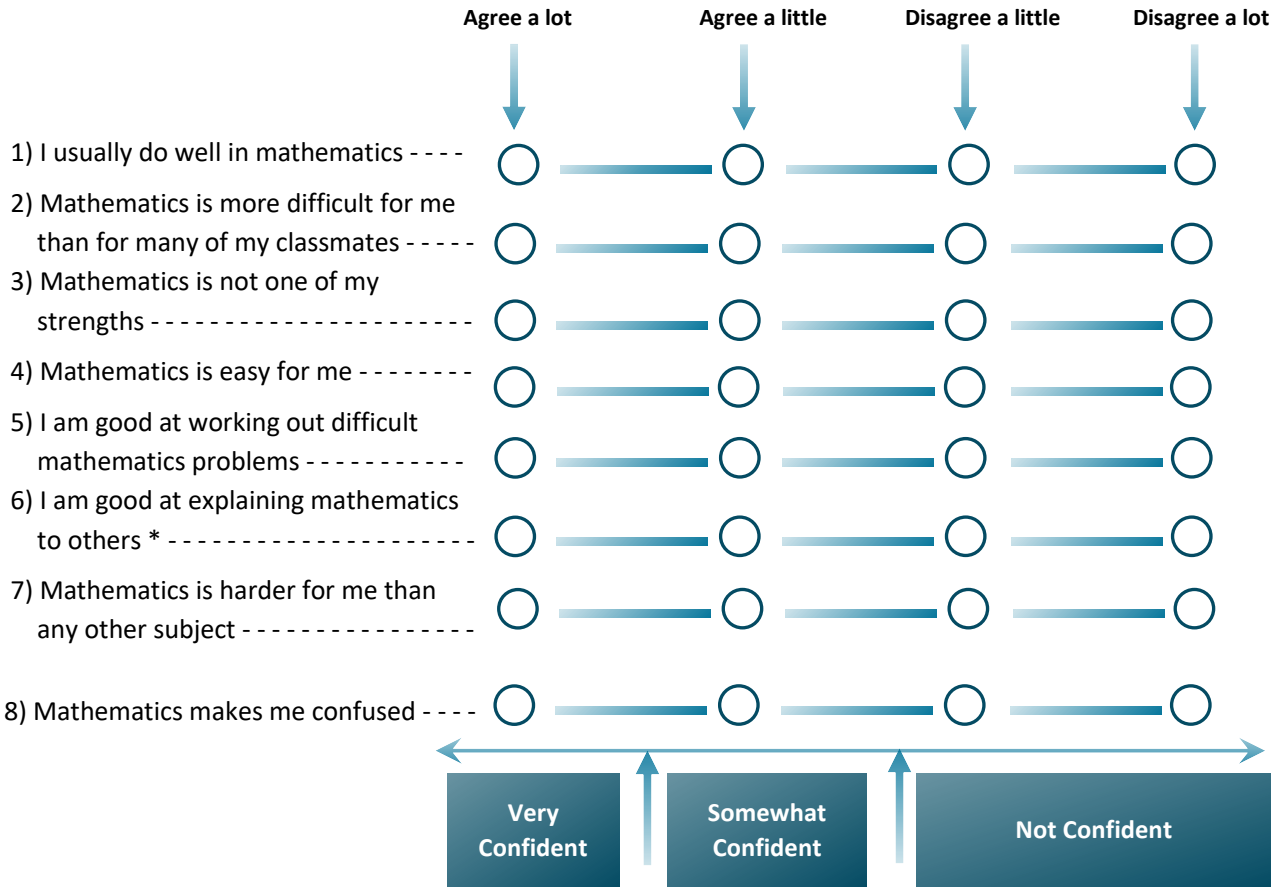
The sense of self-efficacy and beliefs about one's cognitive abilities begin to form during schooling. The school environment is where cognitive skills are "tested" and beliefs about those skills are reinforced through grades, teacher feedback, and social comparison with peers (Bandura, 1989).

Scholars actively study the relationship between self-efficacy and academic performance or achievement. Within the TIMSS framework, the analysis of the link between self-efficacy and student academic achievement represents one of the key research directions.

Insert: *How Student Self-Efficacy Is Assessed in TIMSS 2023*

Illustration 4. statements[2] of self-efficacy scale in mathematics (Students Confident in Mathematics)

How much do you agree with these statements about mathematics[3]?



* Item not included in scale at the fourth grade

[2] The Student Confident in Mathematics (Science) scale is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **Very Confident, Somewhat Confident, and Not Confident**.

[3] To assess students' self-efficacy in science subjects, students were asked similar questions regarding science as well.

TIMSS 2023: Self-Efficacy and Mathematics

TIMSS 2023 reveals that Georgian 4th-grade students are more confident in mathematics than 8th graders. In 8th grade, the number of confident students significantly decreases, while the number of students lacking confidence doubles. This downward trend in confidence from 4th to 8th grade is also evident in international TIMSS data.

Moreover, the proportion of highly confident (Very Confident) 4th graders in Georgia is higher than the international average. Since confidence refers to a person's belief in their own abilities (James, 1890), it is conceptually very close to the notion of self-efficacy. Therefore, in this report, the terms self-efficacy and confidence are used interchangeably.

According to the 2023 TIMSS study findings, **the more confident 4th- and 8th-grade students are in mathematics, the higher their achievement levels** (see Table N3).

Table 3. Indices of Confidence and achievements in Mathematics

Mathematics	Very Confident		Somewhat Confident		Not Confident	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	37% (1.1)	530 (3.2)	41% (0.9)	496 (4.1)	22% (1.0)	469 (3.7)
Grade 8	15% (0.8)	547 (4.6)	32% (0.9)	492 (3.6)	53% (1.1)	436 (3.6)
TIMSS International results						
Grade 4	27% (0.1)	554 (0.5)	42% (0.1)	506 (0.5)	31% (0.1)	467 (0.5)
Grade 8	13% (0.1)	555 (0.8)	32% (0.1)	500 (0.6)	55% (0.2)	446 (0.5)

Additional Evidence

There is a substantial body of empirical evidence showing that the more strongly students believe in their mathematical abilities and skills, the better they learn mathematics and the more successful they are in this field (Skaalvik & Skaalvik, 2006). Students' confidence and belief that they can solve mathematical problems predict their cognitive, emotional, and behavioral engagement in mathematics lessons. Moreover, higher self-efficacy is associated with lower levels of dissatisfaction with math classes (Ozkal, 2019).

A study conducted among 10th-grade students to examine the link between self-efficacy and academic success in mathematics (Liu & Koirala, 2009) showed that students who believed in their ability to solve complex problems and equations significantly outperformed their less confident peers.

Findings from TIMSS and other research confirm that the higher a student's sense of self-efficacy in mathematics, the higher their achievement. However, if a student has not developed the specific skills needed to solve math problems, confidence alone is not enough to lead to success (Schunk, 1991). This is illustrated by a study (Chen, 2003) that aimed to investigate the relationship between 7th-grade students' mathematical abilities (prior achievement), their sense of self-efficacy, and academic performance. The results showed that the combination of confidence and well-practiced problem-solving skills had a stronger impact on academic achievement in mathematics than skills alone.

Self-Efficacy in Science Subjects

Research into the concept of self-efficacy is just as interesting and important in science subjects (physics, chemistry, biology). Scientists are working to gather empirical evidence on how students' belief in their ability to succeed in science impacts their academic performance (Britner & Pajares, 2006).

According to TIMSS 2023, the **higher the confidence of 4th and 8th-grade students in science subjects (Science, Biology, Physics, Chemistry, Earth Science), the higher their achievement** (see Table 4). TIMSS 2023 also shows that students' confidence in science declines with age. Other studies have similarly described a drop in interest in this field after primary school (Barth et al., 2011; Rice et al., 2013; Rittmayer & Beier, 2008), a trend which researchers consider a key factor contributing to the shortage of professionals in science-related careers (Maltese & Tai, 2011; OECD, 2017).

In 8th grade, TIMSS 2023 reports particularly high proportions of students with low confidence in their academic skills and success potential in physics and chemistry. This low confidence may be related both to the *perceived difficulty* of the subject and to less motivating teaching approaches and insufficiently supportive learning environments.

Table 4. Indices of Confidence and achievements in science subjects

Science	Very Confident		Somewhat Confident		Not Confident	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's result						
Grade 4						
Science	36 (1.2)	490 (3.6)	33 (0.9)	470 (4.1)	31 (1.1)	446 (5.2)
Grade 8						
Biology	24 (1.1)	490 (4.5)	42 (1.1)	455 (3.5)	34 (1.1)	432 (3.7)
Chemistry	20 (1.0)	499 (5.2)	37 (0.9)	455 (3.4)	43 (1.0)	435 (3.1)
Physics	15 (1.0)	506 (5.2)	32 (0.9)	461 (4.2)	54 (1.3)	438 (3.1)
Earth Science	22 (1.2)	488 (4.7)	39 (1.2)	457 (4.3)	39 (1.1)	435 (3.2)
TIMSS International results						
Grade 4						
Science	34 (0.2)	530 (0.5)	35 (0.1)	497 (0.5)	31 (0.1)	463 (0.6)
Grade 8						
Biology	17 (0.2)	503 (1.4)	44 (0.2)	462 (0.9)	39 (0.3)	437 (1.0)
Chemistry	13 (0.2)	516 (1.7)	36 (0.2)	467 (1.0)	50 (0.3)	440 (0.9)
Physics	12 (0.2)	525 (1.6)	35 (0.2)	474 (1.0)	53 (0.3)	442 (0.8)
Earth Science	17 (0.2)	495 (1.7)	43 (0.3)	457 (1.0)	40 (0.3)	431 (1.0)

Additional Evidence

Other studies also show that self-efficacy has a significant impact on students' academic performance and career decisions in *Science* (Britner & Pajares, 2006; Lee et al., 2016). For example, students with a high sense of self-efficacy in these subjects are more actively engaged in lessons, complete homework more regularly, and are not intimidated by challenges. On the other hand, students with lower self-efficacy tend to avoid or withdraw from science-related activities and put in less effort when studying. According to multiple studies (Britner & Pajares, 2006; Jansen, Scherer, & Schroeders, 2015; Lau & Roeser, 2002; Valentine, DuBois, & Cooper, 2004), self-efficacy in science is a predictor of higher academic achievement; a lack of confidence in science-related skills is associated with lower interest in science careers and a decline in workforce participation in this field (Zeldin & Pajares, 2000).

Gender Differences – Do Girls or Boys Have Higher Self-Efficacy?

Gender differences in self-efficacy in mathematics and science have long been a focus of research. Although gender equality has significantly improved in the modern world, challenges related to this issue remain relevant. Research indicates that students' perceptions of self-efficacy vary by *gender*, although these differences are not necessarily reflected in academic outcomes. Below we explore in detail empirical data on gender differences in mathematics and science self-efficacy and their possible causes.

Are Girls More Confident in Math Than Boys?

Gender differences in mathematics self-efficacy have been studied since the second half of the 20th century. There is empirical evidence suggesting that boys feel more confident in their math abilities than girls (Fennema & Sherman, 1977; Todor, 2014). Furthermore, girls tend to view math ability as a fixed trait – they believe it is an unchangeable, inherited characteristic that cannot be significantly developed through practice or learning. Simply put, girls believe they are not suited for mathematics and that they will never be successful in it. In contrast, boys tend to believe they possess the necessary skills for math and that they can continue to improve them (Todor, 2014). Some researchers refer to this gender gap as the "**Confidence Gap**" (Sadker & Sadker, 1994) which persists even when boys and girls have equal academic achievement (Watt, 2006). Academic success in mathematics is closely linked to gender stereotypes – girls often believe that math is "for men" and express more negative attitudes toward both the subject and their own abilities (Nosek et al., 2002), often influenced by parental expectations (Eccles et al., 1982). Other studies show that math self-efficacy among girls and boys is shaped by traditional gender roles (Mozahem et al., 2021). As a result, girls often feel uncomfortable in fields associated with men and masculinity (Mendick, 2005). Girls' weaker sense of academic belonging in math and science (Tellhed et al., 2017) may stem from a lack of belief in their ability to build a successful career in these fields. They may also lack a sense of identification with math and science and do not expect acceptance, appreciation, or positive feedback from professionals in those domains. This explains why girls are less involved in math-related activities.

According to TIMSS 2023, boys are more confident in math than girls (**Grade 4**: *boys* - M = 10.65, SD = 1.95; *girls* - M = 10.49, SD = 1.92; **Grade 8**: *boys* - M = 10.39, SD = 1.95; *girls* - M = 9.99, SD = 2.16 and this difference is statistically significant in both cases, $p < 0.001$).

Are Girls More Confident in Science Than Boys?

Regarding science subjects, TIMSS 2023 data show that in 4th grade boys are less confident (M = 10.09, SD = 2.08) than girls (M = 10.29, SD = 2.13), and this difference is also statistically significant (t (41468) = 9.87, p < 0.001). In the 8th grade, girls are more confident in biology and chemistry, while boys are more confident in physics. In Earth science, the difference is not statistically significant.

Other studies on gender differences show that girls are more likely than boys to believe they can handle science tasks. However, they also experience more anxiety about academic performance in these subjects. Some research even finds that girls score higher than boys in subjects like physics, chemistry, and biology (Britner & Pajares, 2005).

It is worth noting that findings in this area are not consistent. For example, under controlled conditions—when boys and girls had equal academic performance—girls still reported lower self-efficacy in science (Juan et al., 2018). Researchers attribute this to general stereotypes and traditional views that science is more appropriate for boys. This could explain why more boys than girls choose science-related careers—they believe they have the necessary skills and are more likely to feel a sense of belonging in the field.

TIMSS 2023 also shows that students' confidence, not just achievement, declines during the transition from primary to lower secondary education. According to one study (Eccles, 1983), boys and girls had similar self-confidence levels in math during the early grades, but as they aged, boys' self-efficacy surpassed that of girls. This may be explained by the greater influence of social factors on teenagers compared to younger students. In other words, gender stereotypes promoted by media, culture, and family (Phillips & Zimmerman, 1990) may have a stronger effect on students in grades VIII–XII than those in grades I–VII.

Gender differences in education demand attention. It is essential to develop interventions that effectively boost girls' self-confidence and counteract stereotypical thinking. In psychology and educational research, the "**Growth Mindset**" concept is gaining prominence. According to this approach, **ability is not fixed** and can be improved through effective teaching, practice, and motivation. In short, practice and the right approach play a key role in learning math or science and in developing relevant skills.

Digital self-efficacy

Within the framework of TIMSS 2023, researchers examined not only students' confidence in mathematics and science, but also their digital self-efficacy, which refers to students' perceived ability and confidence in using modern technologies.

The 21st century can confidently be described as the digital era, as digitalization affects all aspects of human life, including education and employment (Ulfert-Blank & Schmid, 2022). Consequently, digital skills have become some of the most essential and fundamental competencies, now considered key predictors of success. Understandably, scientific interest in digital self-efficacy has grown, and recent years have seen an accumulation of empirical evidence on this topic. The use of digital systems—such as computers, smartphones, and various applications—is now regarded as one of the most important

competencies in the 21st century across education, work, and everyday life (OECD, 2016, OECD, O. for economic C. and development, 2016). Moreover, given the rapid development of the digital sector in recent years—particularly advancements like artificial intelligence (Parker & Grote, 2020)—people are increasingly faced with the challenge of keeping pace with the digital revolution and managing complex systems and tasks (Vrontis et al., 2021). As a result, it is evident that individuals must become more competent and adaptive so that their skills align with the dramatic shifts in the digital industry (Larson & DeChurch, 2020).

Digital self-efficacy is recognized as one of the most reliable predictors of learning motivation and academic achievement (Chang et al., 2014). It is particularly significant in the context of acquiring new skills (Kapucu & Bahcivan, 2015). Therefore, it follows that the higher a student's level of digital self-efficacy, the greater their academic achievement is likely to be.

TIMSS 2023 data confirms that **students with a high sense of digital self-efficacy tend to perform better in both mathematics and science** (see Table 5; Table 6).

Table 5. Digital Self-Efficacy and Achievement in Mathematics

	High Digital Self-Efficacy		Medium Digital Self-Efficacy		Low Digital Self-Efficacy	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	38% (1.3)	511 (3.3)	53% (1.2)	502 (3.4)	9% (0.6)	477 (7.4)
Grade 8	59% (1.2)	481 (3.0)	38% (1.1)	456 (4.7)	3% (0.4)	444 (11.9)
TIMSS International results						
Grade 4	36% (0.1)	518 (0.5)	49% (0.1)	503 (0.4)	15% (0.1)	477 (0.8)
Grade 8	56% (0.2)	492 (0.7)	37% (0.1)	459 (0.6)	6% (0.1)	408 (1.5)

Table 6. Digital Self-Efficacy and Achievement in Science

	High Digital Self-Efficacy		Medium Digital Self-Efficacy		Low Digital Self-Efficacy	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	38% (1.3)	481 (3.8)	53% (1.2)	467 (3.7)	9% (0.6)	442 (6.7)
Grade 8	59% (1.2)	464 (2.7)	38% (1.1)	438 (4.6)	3% (0.4)	421 (9.9)
TIMSS International results						
Grade 4	36% (0.1)	512 (0.5)	49% (0.1)	493 (0.5)	15% (0.1)	468 (0.9)
Grade 8	56% (0.2)	493 (0.8)	37% (0.1)	456 (0.6)	6% (0.1)	396 (1.3)

It is worth noting that Georgian students' levels of digital self-efficacy are very close to international trends. In fact, the proportion of students with high digital confidence is slightly higher in Georgia. While students' confidence in mathematics and science tends to decline from Grade 4 to Grade 8, digital self-

efficacy shows the opposite trend—increasing from Grade 4 to Grade 8—both in Georgia and internationally.

This upward trend in students' digital self-efficacy presents an opportunity to improve the teaching of mathematics and science. For example, integrating technological resources into these subjects may help students build greater confidence and engage more effectively in the learning process.

In the context of global digital transformation, the importance of digital self-efficacy will continue to grow. Therefore, education systems must develop targeted approaches that enable students and citizens not only to acquire technical knowledge but also to build self-confidence and adaptability in the digital environment.

What Shapes Students' Sense of Self-Efficacy?

Researching and analyzing the factors that determine students' self-efficacy is a critical prerequisite for creating an educational environment that intentionally fosters student motivation and engagement, ultimately contributing to improved academic achievement. In the learning process, self-efficacy is shaped not only by individual characteristics but also by the diverse influences of the social and structural context of teaching and learning. Findings from TIMSS 2023 reveal several important trends that support this understanding:

- **Instructional Clarity** emerged as one of the key factors significantly influencing students' confidence in mathematics and science. This highlights the important role that teaching methods, lesson structure, and communication quality play in shaping students' perceptions of their own effectiveness;
- **Home Educational Resources** play a substantial role in forming students' self-efficacy, underlining the value of family social capital in developing academic confidence;
- **Sense of School Belonging** strongly enhances students' confidence, emphasizing the importance of emotional and social well-being. A supportive environment that ensures emotional safety and fosters strong social connections is vital in helping students build and sustain belief in their abilities.
- **School Emphasis on Academic Success**—somewhat paradoxically—can, in certain cases, have a negative impact on students' confidence. This suggests that excessive focus on achievement and high expectations may become a source of pressure and stress for some students, thereby undermining their sense of self-efficacy.

These findings suggest that self-efficacy development is highly dependent on both the effectiveness of teaching (clarity of instruction) and the emotional safety and supportiveness of the school environment. It is within such classroom and school settings that students' confidence in their abilities grows—leading, in turn, to increased motivation and academic success.

These insights are based on the results of a **multifactor regression analysis**, detailed in the annex below.

Insert: Multivariate Regression Analysis

Grade 8

Dependent Variable: Student Confidence in Mathematics and Science

Predictors: Instructional Clarity in Mathematics and Science Lessons, Home Educational Resources, Sense of School Belonging, Emphasis on Academic Success.

The regression analysis evaluated five models:

1. Confidence in Mathematics: The model explains approximately 10.5% of the variance in student confidence ($R^2 = 0.105$; $F(4, 35934) = 1057.10$, $p < 0.001$);

The strongest positive predictor is Home Educational Resources (ß = 0.194, $p < 0.001$) – Students with supportive learning resources at home are more confident in mathematics.

Instructional Clarity in Mathematics Lessons (ß = 0.147, $p < 0.001$) and Sense of School Belonging (ß = 0.163, $p < 0.001$) also show significant positive associations.

School Emphasis on Academic Success (ß = -0.009 p = 0.063) is not statistically significant.

2. Confidence in Biology: The model explains 15.2% of the variance ($R^2 = 0.152$, $F(4, 33573) = 1503.52$, $p < 0.001$);

Instructional Clarity is the strongest predictor (ß = 0.283, $p < 0.001$), emphasizing the importance of structured lessons and clear guidance.

Home educational resources (ß = 0.178, $p < 0.001$) and Sense of School Belonging (ß = 0.116, $p < 0.001$) are also positively associated with confidence.

School Emphasis on Academic Success (ß = -0.026, $p < 0.001$) is negatively associated with confidence, suggesting that overemphasis may be counterproductive for some students.

3. Confidence in Physics: The model explains 13.6% of the variance ($R^2 = 0.136$; $F(4, 32789) = 1288.16$, $p < 0.001$).

The most important predictor is Instructional Clarity (ß = 0.248, $p < 0.001$).

Home Educational Resources (ß = 0.159, $p < 0.001$) and Sense of School Belonging (ß = 0.156, $p < 0.001$) are positively associated.

School emphasis on academic success (ß = -0.029, $p < 0.001$) has a negative association with student confidence.

Here we note that in the two models discussed below, a school's emphasis on academic achievement has a different (negative) effect, which may be related to the subject's specificity. Overall, the results suggest that a balanced approach to academic success (reflected in goal clarity, motivation, and discipline) may enhance students' self-confidence, whereas excessive strictness may lead to pressure, fear, and lower self-esteem.

4. Confidence in Chemistry: The model explains 14.6% of the variance ($R^2 = 0.146$; $F(4, 32948) = 1406.6$, $p < 0.001$).

Instructional Clarity (ß = 0.293, $p < 0.001$) is a strong predictor, showing a clear link between teacher communication and student confidence.

Home Educational Resources (ß = 0.137, $p < 0.001$) and Sense of School Belonging (ß = 0.132, $p < 0.001$) also have positive effects.

School Emphasis on Academic Success was not statistically significant.

5. Confidence in Earth Science: The model explains 14.6% of the variance.

The strongest predictor is Instructional Clarity in earth science lessons (ß = 0.283, $p < 0.001$).

Home Educational Resources (ß = 0.168, $p < 0.001$) and Sense of School Belonging (ß = 0.116, $p < 0.001$) also play significant roles.

School Emphasis on Academic Success (ß = 0.068, $p < 0.001$) has a small but positive effect on confidence.

3. Bulling

Bulling and academic success:

How bulling limits students potential

In the reality of the 21st century, bullying Is one of the most pressing and important issues. Bullying typically involves repeated behaviors intended to harm another person (Olweus, 2013). The literature identifies four main types of bullying: physical, verbal, relational, and cyberbullying (Wang et al., 2009). *Physical bullying* refers to individuals or groups intentionally causing physical harm to others; *Verbal bullying* involves one person insulting or offending another through words (e.g., calling them mocking or offensive names); *Relational bullying* consists of socially excluding individuals from peer groups (Crick & Grotpeter, 1995). *Cyberbullying*, which has gained particular attention in the digital age, refers to the use of social media platforms (Facebook, Instagram, WhatsApp, TikTok, etc.) to harass, threaten, or publicly humiliate others (Butler et al., 2009).

Bullying and Academic Achievement

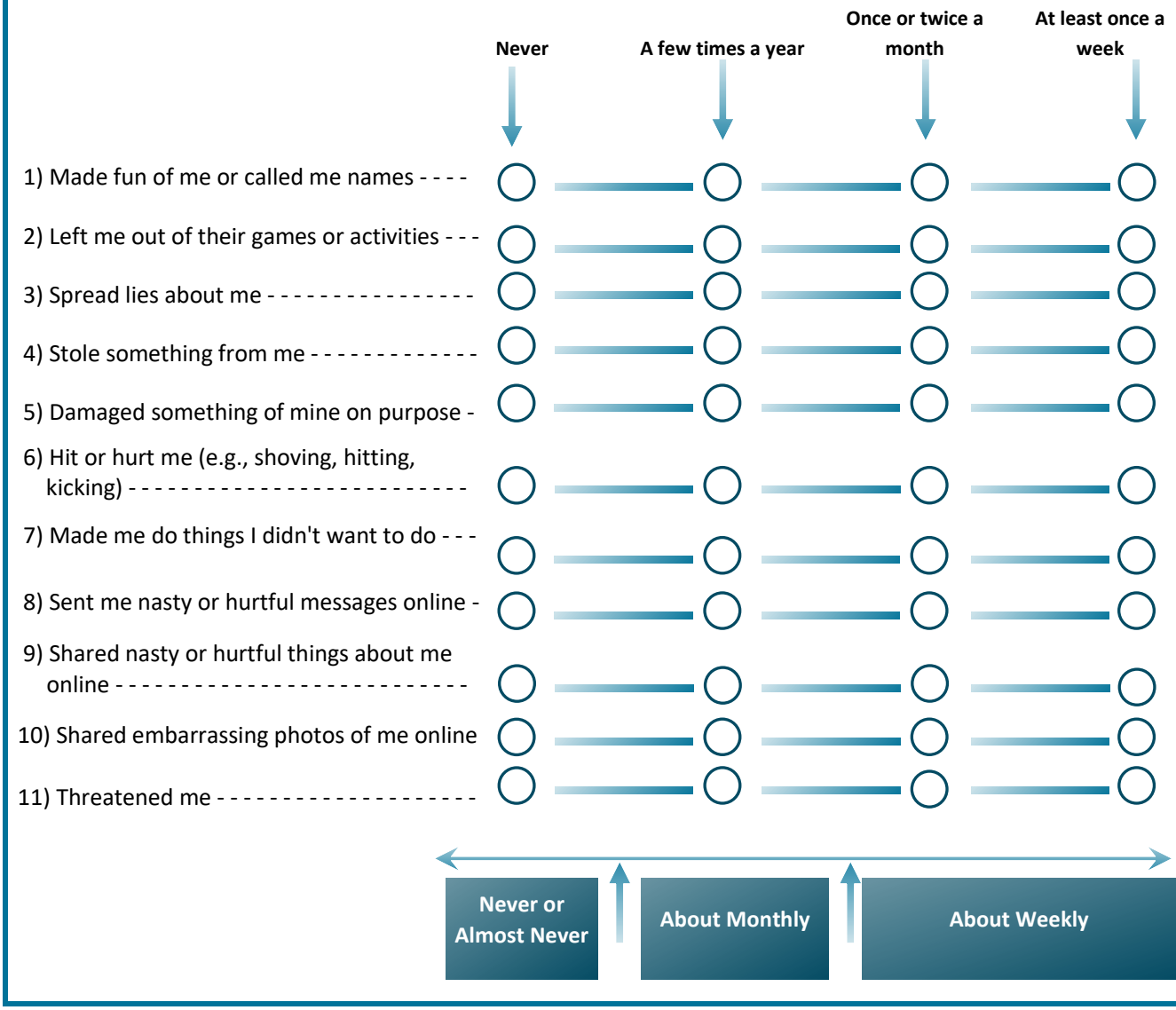
Bullying threatens one of the most basic human needs—a sense of safety (Maslow, 1943). It is associated with increased vulnerability to stress, weakened coping mechanisms in difficult situations (Troop-Gordon et al., 2017), and a greater risk of depression (Ttofi et al., 2011a, b). As a result, scholarly interest in the causes, consequences, and effective interventions related to bullying has grown steadily in recent years (Berger et al., 2011; Menting et al., 2011).

It is clear that obtaining empirical data on both the causes and effects of bullying is crucial for developing effective solutions. In this section, we will review empirical evidence on the relationship between bullying and academic achievement/performance. In the final chapter, we will offer recommendations and possible interventions aimed at preventing or reducing bullying.

Inset: How Bullying Is Measured in TIMSS 2023

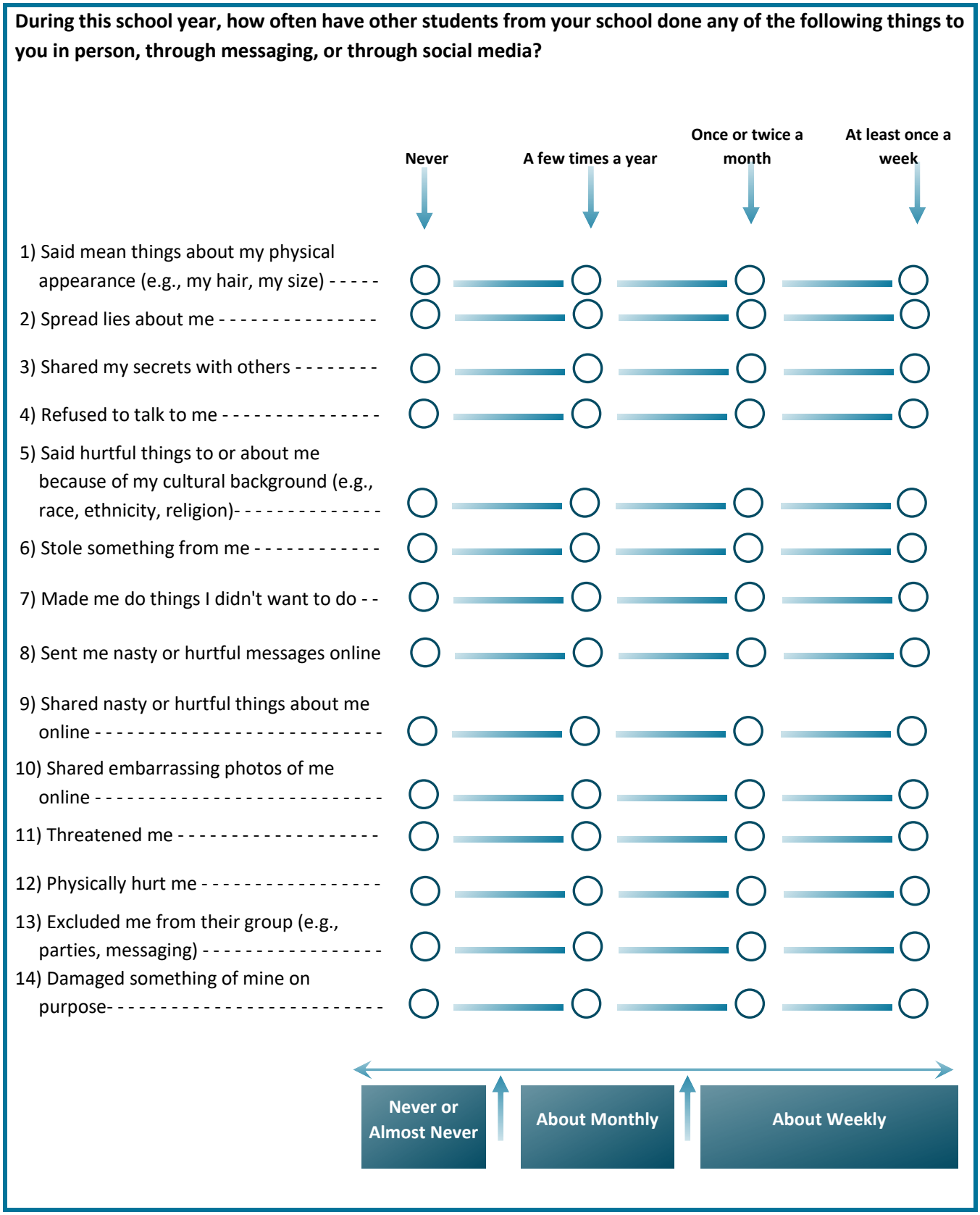
Illustration 5. Statements of the Bullying Scale (Grade 4)[4]

During this school year, how often have other students from your school done any of the following things to you in person, through messaging, or through social media?



[4] The Bullying scale is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **Never or Almost Never, About Monthly, About Weekly**.

Illustration 6. Statements of the Bullying Scale (Grade 8)



TIMSS 2023: Bullying and Student Achievement in Mathematics and Science

As the results of the **TIMSS 2023** study show, bullying is not a rare occurrence in Georgian schools. About 31% of fourth-grade students and 18% of eighth-grade students report having experienced bullying at least once a week or once a month. Compared to the international averages from TIMSS, the prevalence of bullying in our schools is significantly lower. However, this result should not lead to complacency—schools must work on developing preventive strategies to ensure a safe and supportive learning environment for all students.

The absence or low incidence of bullying is a key factor in promoting students' emotional well-being, strengthening social connections, and fostering a positive school climate. In turn, these aspects influence students' academic motivation and overall school experience. According to the TIMSS 2023 findings, **the less bullying students experience, the higher their achievement in mathematics and science in both the fourth and eighth grades** (see Table 7; Table 8).

Table 7. Bullying Experience and Achievement in Mathematics

	Never or Almost Never		About Monthly		About Weekly	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	69% (1.2)	514 (3.1)	18% (0.9)	498 (5.3)	13% (0.7)	448 (4.8)
Grade 8	81% (0.8)	476 (3.4)	11% (0.7)	462 (5.2)	7% (0.6)	433 (7.7)
TIMSS International results						
Grade 4	53% (0.2)	520 (0.5)	31% (0.1)	504 (0.5)	15% (0.1)	461 (0.7)
Grade 8	60% (0.1)	487 (0.6)	27% (0.1)	472 (0.7)	13% (0.1)	429 (1.0)

Table 8. Bullying Experience and Achievement in Science

	Never or Almost Never		About Monthly		About Weekly	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	69% (1.2)	481 (3.4)	18% (0.9)	464 (4.8)	13% (0.7)	417 (4.9)
Grade 8	81% (0.8)	458 (2.9)	11% (0.7)	445 (5.8)	7% (0.6)	408 (8.7)
TIMSS International results						
Grade 4	53% (0.2)	513 (0.5)	31% (0.1)	495 (0.5)	15% (0.1)	450 (0.8)
Grade 8	60% (0.1)	488 (0.6)	27% (0.1)	471 (0.7)	13% (0.1)	420 (1.0)

Other Empirical Evidence

Other studies also confirm this connection: the more students experience bullying, the lower their academic performance and achievement levels (Rusteholz et al., 2021). According to one study (Ponzo, 2013), fourth-grade students who were victims of bullying scored, on average, 10 points lower on mathematics tests and 12 points lower in science compared to those who had never experienced bullying. The same study found that the negative impact of bullying on academic achievement persisted with age: by eighth grade, students who had experienced bullying scored 13 points lower in mathematics and 8 points lower in science on average.

It is also worth noting that, unlike other subjects, the impact of bullying on mathematics achievement was found to be strongest among high-performing students. Specifically, the more successful a student was in mathematics, the more strongly bullying affected their performance. This finding is not surprising given that high-performing students likely invest more time, effort, and emotional or intellectual resources into achieving success in mathematics. After experiencing bullying, their emotional resources are often depleted, making it difficult for them to both cope with the bullying and maintain high academic performance in math.

Since bullying causes serious physical and emotional harm to students, it is critically important that teachers can recognize bullying incidents in the classroom and take appropriate measures to reduce or prevent them. To do so, we need to identify, on the one hand, strategies that help prevent bullying and, on the other, the factors that protect students from its effects.

Visible and Invisible Sources of Bullying: What Does TIMSS 2023 Tell Us? What causes bullying? TIMSS 2023 data does not provide a clear, definitive answer to this question. Regression analysis conducted to identify factors associated with bullying yielded statistically insignificant results, suggesting that the causes of bullying may be more complex and influenced by indirect or "invisible" factors. It is possible that the variables included in the regression model do not fully capture the complex nature of the bullying phenomenon. However, analysis did reveal certain tendencies, which are discussed below.

A correlational analysis of TIMSS 2023 data showed a weak but statistically significant positive relationship between lower levels of bullying and students' sense of school belonging ($r = 0.24$, $p < 0.001$). This finding aligns with general conclusions found in psychological and educational research on bullying. The result can be interpreted through several key factors: experiencing bullying often leads to social isolation and a sense of exclusion from the group, which naturally reduces a student's sense of belonging at school. A negative emotional climate and school-related stress, coupled with a lack of social support, cause students to perceive school not as a safe and pleasant place, but rather as a hostile and stressful environment. These emotional responses reduce students' sense of belonging and also decrease motivation and academic engagement.

TIMSS 2023 also shows a moderate positive relationship between the experience of bullying and deviant behavior[5] during mathematics lessons ($r = 0.39$, $p < 0.001$). This result suggests that bullying may contribute to the emergence of undesirable behaviors in the classroom, further confirming its negative social consequences.

[5] Deviant behavior is an act or behavior that violates the norms, rules, or expectations accepted in society

Experiencing less bullying was found to be weakly positively correlated with students' confidence in mathematics, their positive attitudes toward the subject, and their perception of the value of science subjects. Although these correlations are weak, they still point to the negative impact of bullying on students' self-perception and attitudes toward academic subjects.

Overall, bullying requires further research and in-depth, context-sensitive analysis that considers both individual and systemic or cultural school-level factors. Since we lack robust evidence about the underlying conditions of bullying in schools, we will now examine findings from other research studies.

What Do Other Studies Teach Us About Bullying?

Human behavior does not follow simple rules, as it is shaped by a multitude of factors acting simultaneously. It is therefore clear that certain factors may moderate the relationship between bullying and academic achievement—either strengthening or weakening it. In the next section, we will examine these moderating factors that may have a protective effect.

According to one study (Oliveira et al., 2018), **social-emotional skills** help students cope with bullying. In other words, the stronger students' defense mechanisms are, the less bullying affects their academic performance in mathematics. This implies the importance of developing students' social-emotional skills and teaching them how to overcome emotional challenges so that obstacles interfere less with their academic success.

In addition, lower levels of bullying are associated with higher **self-esteem**. The lower the incidence of bullying and the higher a student's self-esteem, the greater the likelihood of high academic performance in mathematics (Álvarez & Szücs, 2023). Self-esteem may serve as a protective factor in the context of the negative effects of bullying (i.e., it reduces the impact of bullying). However, it is difficult to determine causal relationships: does bullying lower self-esteem, or are students with high self-esteem less likely to become victims of bullying?

The prevalence of bullying is lower among students who are **self-confident** and actively engaged in classroom activities (Winnaar et al., 2018). It is important for school policies to support not only academic development, but also the social-emotional needs of students—such as boosting self-confidence, building self-esteem, and developing social skills.

Based on the studies discussed above, it is clear that planning anti-bullying interventions should be high on the education agenda to ensure that students have the opportunity to learn in a safe environment. This is essential not only for their emotional well-being, but also for their academic achievement and future success.

The section on recommendations describes how schools should respond to this challenge, what prevention mechanisms are effective, and how to minimize the negative consequences of bullying.

4. Academic Emotions

Power of positive attitude:

Learning, motivation and achievement

One of the key factors associated with students' academic achievement is their attitudes. An attitude is a positive or negative emotional disposition, a stance, or mindset toward a particular subject or issue (Tahar et al., 2010). In other words, when we speak about students' attitudes, we refer both to their rational views (how valuable they perceive a subject to be) and their emotional connection – how much they enjoy engaging in activities related to that subject (e.g., mathematics).

According to various studies (Mohamed & Waheed, 2011; Mata, Monteiro & Peixoto, 2012; Ngussa & Mbuti, 2017), students' attitudes toward different subjects play a crucial role in their academic achievement. Attitudes change and develop over time (Syeda, 2016), and forming a positive attitude influences the effectiveness of the learning process (Akinsola & Olowojaiye, 2008; Mutai, 2011). On the other hand, a negative attitude hinders quality learning and student achievement in a given subject (Joseph, 2013). Below, we will take a closer look at empirical evidence on the relationship between attitudes (e.g., "I like mathematics") and student achievement, engagement, confidence or other factors. We begin with an overview of the TIMSS 2023 findings.

Students' Attitudes and Academic Achievement

Mathematics

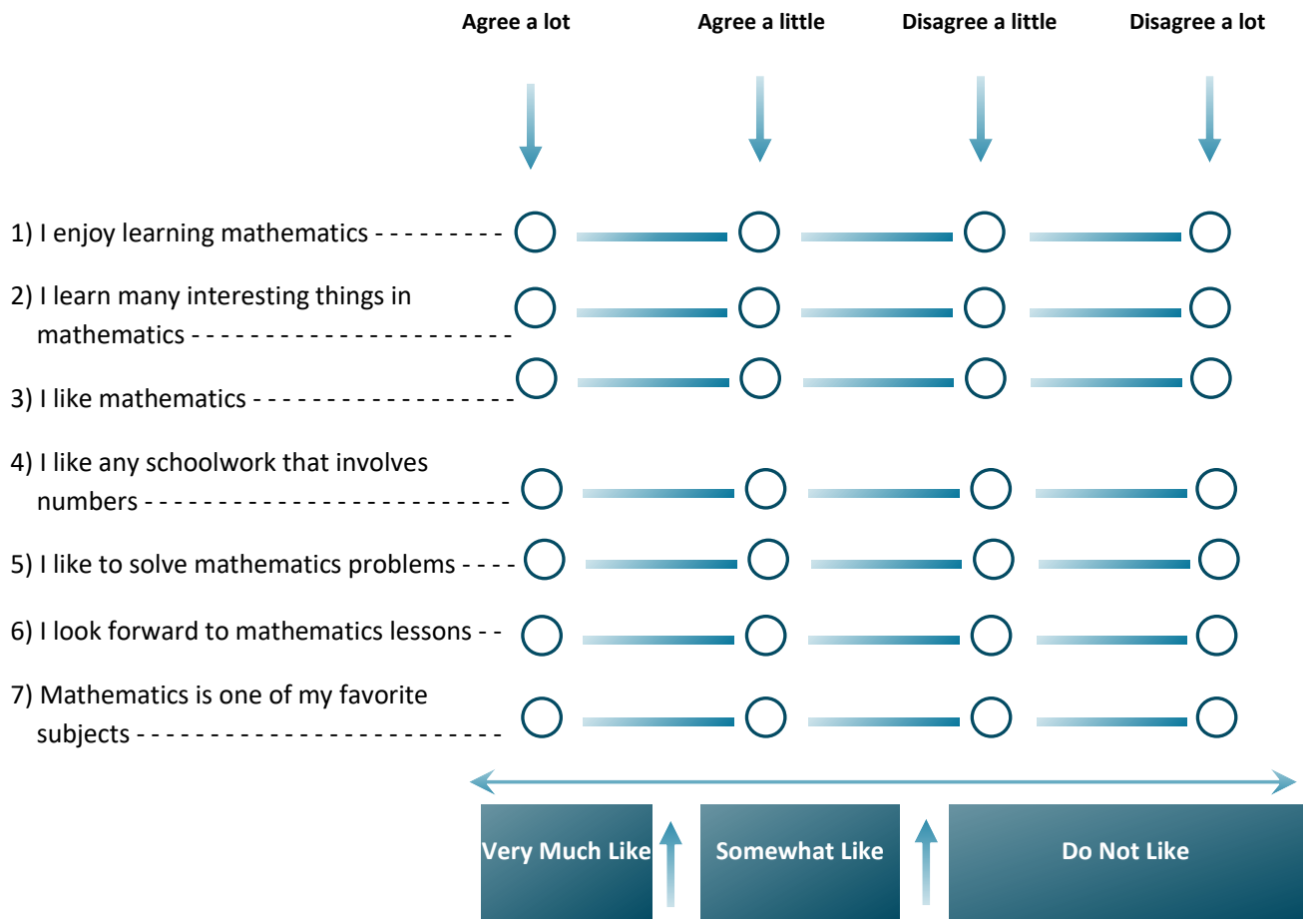
Students' attitudes toward mathematics play a significant role in their academic success. Research shows that having a positive attitude toward mathematics and experiencing enjoyment while learning the subject are directly linked to better academic outcomes (Mullis et al., 2012; Ma, 1997). In contrast, a negative attitude toward mathematics — perceiving it as boring or holding beliefs that it is difficult or uninteresting — leads to lower engagement and reduced academic achievement (Brown et al., 2008).

Furthermore, attitudes toward mathematics are related to students' self-confidence and their belief in their ability to successfully solve mathematical problems (Adelson & McCoach, 2011; Mazana et al., 2019). Students who feel confident are more willing to face challenges, which boosts their motivation and academic performance (Hannula et al., 2004). At the same time, those who doubt their abilities tend to be less interested in mathematics and often do not perceive it as a valuable subject.

Inset: *How Students' Attitudes Toward Mathematics Are Measured in TIMSS 2023*

Illustration 7. Statements of the Scale Measuring: Students Like Learning Mathematics[6]

How much do you agree with these statements about learning mathematics?



[6] The scale: **Students Like Learning Mathematics** is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **Very Much Like, Somewhat Like, Do Not Like**.

According to the TIMSS 2023 study, the more positive students' attitudes toward mathematics are in Grade 4 and Grade 8, the higher their achievement in mathematics (see Table 9).

Table 9. Student Like Mathematics and Achievement

Mathematics	Very Much Like		Somewhat Like		Do Not Like	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Georgia's results						
Grade 4	68% (1.2)	509 (3.0)	26% (1.0)	491 (4.0)	6% (0.4)	480 (7.9)
Grade 8	25% (1.3)	501 (4.8)	38% (0.9)	475 (3.8)	37% (1.2)	446 (3.4)
TIMSS International results						
Grade 4	44% (0.1)	519 (0.5)	32% (0.1)	501 (0.5)	24% (0.1)	487 (0.7)
Grade 8	21% (0.1)	508 (0.8)	32% (0.1)	488 (0.7)	46% (0.2)	458 (0.6)

The strong link between positive attitudes toward mathematics and student achievement is confirmed by other studies as well (Mullis et al., 2012); enjoying learning mathematics has a direct impact on performance (Ma, 1997). In contrast, students who do not like mathematics tend to find it boring, hold negative beliefs about the subject, and engage less in math lessons (Brown et al., 2008), which results in lower chances of academic success.

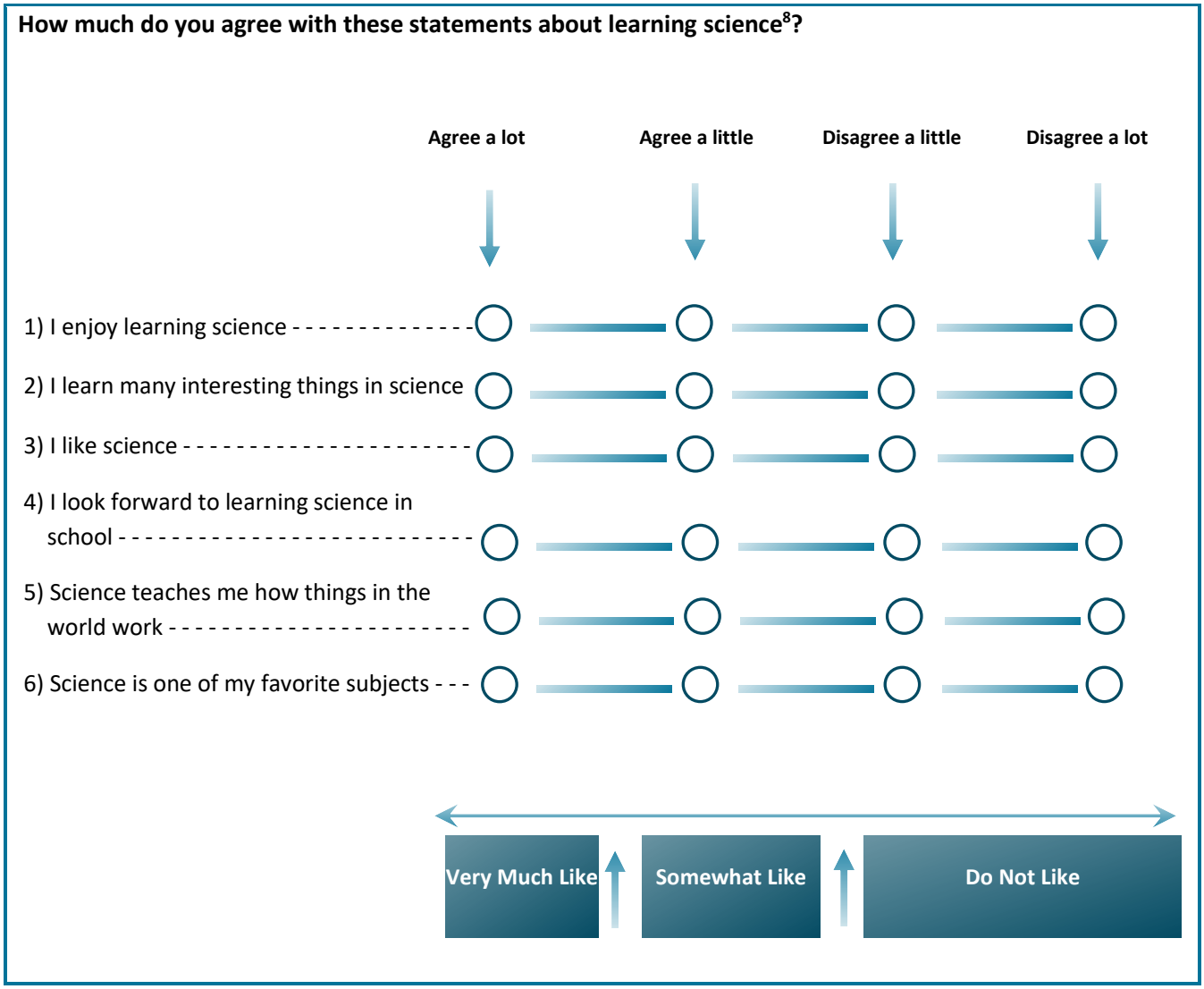
It is noteworthy that the majority of Georgian fourth-grade students have a positive attitude toward mathematics (68%) while the proportion of students who dislike mathematics is relatively small (6%). In this regard, Georgian students' scores exceed the international data reported by TIMSS. However, it is important to note that this attitude changes significantly from Grade 4 to Grade 8. A similar trend is observed in TIMSS international data as well. The decline in student motivation from primary to lower secondary education is confirmed by other research too.

Studies show that an additional source of motivation is students' perception of mathematics as useful and valuable, and their awareness of its connection to real life. Students who recognize the practical value of mathematics in everyday life and in their future plans are more likely to develop an interest in the subject (Adelson & McCoach, 2011). Therefore, it is essential that teachers support the development of positive attitudes toward mathematics, as this not only enhances students' motivation but also promotes their achievement and overall academic success (Syyeda, 2016).

Science

Inset: *How Students' Attitudes Toward Science Are Measured in TIMSS 2023*

Illustration 8. Statements of the Scale Measuring: Students Like Learning Science (Grade 4)[7]



According to the results of the 2023 TIMSS study, in both the 4th and 8th grades, students' achievement is largely aligned with their attitudes toward the subjects. The highest scores are observed among students who report strong liking for the subjects, while the lowest scores are recorded among those who do not like the subjects. For example, in physics, students who like the subject very much achieve a score of 472, which is significantly higher than the score of 445 among students with a negative attitude toward it. In other words, these results indicate that having positive emotions toward science subjects, perceiving them as interesting, and enjoying the learning process is associated with increasing achievement level in those subjects.

[7] The scale: **Students Like Learning Science** is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **Very Much Like, Somewhat Like, Do Not Like**.

[8] Eighth-grade students were asked similar questions for each of the science subjects.

Table 10. Student Like Science and Achievement

Science	Very Much Like		Somewhat Like		Do Not Like	
	Students %	Average achievement	Students %	Average achievement	Students %	Average achievement
Georgia's results						
Grade 4						
Science	61% (1.3)	476 (3.2)	29% (0.9)	462 (4.4)	10% (0.7)	460 (6.3)
Grade 8						
Biology	45% (1.0)	462 (3.3)	34% (0.8)	455 (3.2)	21% (1.0)	445 (4.1)
Chemistry	44% (1.4)	467 (3.3)	30% (0.9)	453 (3.6)	27% (1.3)	440 (3.8)
Physics	33% (1.4)	472 (3.9)	35% (1.1)	451 (4.6)	33% (1.3)	445 (3.4)
Earth science	39% (1.5)	458 (3.7)	35% (1.0)	456 (3.7)	26% (1.3)	451 (3.3)
TIMSS International results						
Grade 4						
Science	53% (0.1)	504 (0.5)	29% (0.1)	493 (0.6)	18% (0.1)	482 (0.8)
Grade 8						
Biology	35% (0.3)	466 (1.1)	35% (0.2)	457 (1.1)	30% (0.3)	454 (1.3)
Chemistry	32% (0.3)	473 (1.2)	32% (0.2)	460 (1.1)	37% (0.3)	451 (1.2)
Physics	30% (0.3)	479 (1.2)	31% (0.2)	463 (1.1)	39% (0.3)	454 (1.4)
Earth science	34% (0.3)	458 (1.2)	34% (0.2)	451 (1.3)	32% (0.3)	450 (1.9)

Gender Differences – Do Girls and Boys Differ in Their Attitudes Toward Mathematics and Science Subjects?

Results of statistical analysis indicate that gender differences in attitudes toward mathematics and science subjects are small, though mostly statistically significant. **Fourth-grade** boys enjoy learning mathematics and science slightly more than girls. This trend continues in the **eighth grade**. However, girls tend to enjoy learning biology more than boys. Regarding chemistry, there is no statistically significant difference between boys and girls in terms of positive attitudes. These findings suggest that a broader context needs to be considered when studying the factors influencing students' attitudes toward these subjects. While gender does have an effect, its impact is small.

TIMSS 2023 – Statistical Analysis Results:

Grade 4

A small but statistically significant difference was found between girls (M = 11.13, SD = 1.40) and boys (M = 11.25, SD = 1.5) in terms of positive attitudes toward mathematics ($t(43379) = -7.4$, $p < 0.001$). However, the effect size is very small (Cohen's d = -0.07), indicating that the practical difference between the groups is negligible.

A similar trend appears for attitudes toward science. The difference is statistically significant ($t(43044) = -2.2$, $p = 0.026$), but again, the mean difference is minimal (Mean Difference = -0.037). Boys (M = 10.41, SD = 1.74) slightly prefer learning science more than girls (M = 10.37, SD = 1.72), with a very small effect size (Cohen's d = -0.02).

Grade 8

Boys (M = 10.65, SD = 1.89) enjoy learning mathematics more than girls (M = 10.28, SD = 1.86), with a statistically significant difference ($t(39099) = -20.04$, $p < 0.001$).

Boys (M = 10.47, SD = 1.91) show slightly more positive attitudes toward learning physics than girls (M = 10.13, SD = 1.90); this difference is statistically significant ($t(35927) = -16.59$, $p < 0.001$).

Boys (M = 10.54, SD = 1.90) also prefer learning earth science more than girls (M = 10.27, SD = 1.88); the difference is statistically significant ($t(36210) = -13.77$, $p < 0.001$).

Girls (M = 10.68, SD = 1.80) have a slightly more positive attitude toward biology than boys (M = 10.38, SD = 1.88); this difference is statistically significant ($t(36541) = 15.65$, $p < 0.001$).

What Factors Influence Students' Attitudes Toward Subjects?

A positive attitude toward a subject is an important factor in students' academic success and engagement in the learning process. Statistical analysis (multivariate regression) helped identify which factors influence students' positive attitudes toward mathematics and science. The strongest predictors were students' **Sense of School Belonging** and **Instructional Clarity**.

- The Sense of Belonging to school was a leading factor for fourth graders – the more they feel safe, calm, and supported at school, and the more they feel valued, the more they enjoy learning mathematics and science. This Sense of Belonging is also important for eighth graders' attitudes toward these subjects.
- The clearer the instructions students receive, and the better they understand tasks and new content, the more they enjoy the learning process. Instructional clarity is an important factor in both grades, but it becomes even more significant in grade 8. As subject content becomes more complex, clear communication becomes critical for effectively learning the material and maintaining a positive attitude. In grade 8, clarity of instruction has the strongest effect on forming positive attitudes toward physics and chemistry.

In summary, students' attitudes toward a subject are influenced both by their emotional connection to the school environment and by the quality of instruction. This suggests that a student's attitude toward a subject is shaped not only by the content or difficulty of the subject, but also by how safe, valued, and supported they feel at school. The stronger the emotional connection to school and the higher the quality of teaching, the more motivated and positively inclined the student is toward the subject—ultimately contributing to greater engagement and academic success.

Insert: Multivariate Regression Analysis

Grade 4

Predictors: Sense of School Belonging, Home Educational Resources, Instructional Clarity, Instruction Affected by Math Resource Shortage, Early Numeracy Tasks before school, Early Numeracy Activities before school, School Emphasis on Academic Success, Early Literacy and Numeracy Activities before school.

Dependent variables: Attitudes toward Mathematics and Science

Mathematics attitudes Model Overview: The model explained 23.5% of the variance in students' interest in learning mathematics ($R^2 = 0.235$; $F(8, 35492) = 1366.0$, $p < 0.001$). The strongest predictors of interest in learning mathematics were Sense of School Belonging ($\beta = 0.33$, $p < 0.001$) and Instructional Clarity in Mathematics Lessons ($\beta = 0.24$, $p < 0.001$). Some predictors had weaker but still statistically significant effects: Early numeracy activities before school ($\beta = -0.09$, $p < 0.001$); Early literacy and numeracy activities before school ($\beta = -0.08$, $p < 0.001$); Early numeracy tasks before school ($\beta = 0.08$, $p < 0.001$); School emphasis on academic success ($\beta = -0.02$, $p < 0.002$).

Science Attitudes Model Overview: The model explained 16.3% of the variance in students' interest in science ($R^2 = 0.163$; $F = 857.95$, $p < 0.001$). The strongest predictors were, again, Sense of School Belonging ($\beta = 0.272$, $p < 0.001$) and Instructional Clarity in Science Lessons ($\beta = 0.20$, $p < 0.001$). Other predictors had weaker but statistically significant effects: Early numeracy activities before school ($\beta = -0.08$, $p < 0.001$); Early literacy and numeracy activities before school ($\beta = 0.05$, $p < 0.001$); Instruction

Affected by Math Resource Shortage (β = 0.02, p < 0.005); School emphasis on academic success (β = -0.03, p < 0.001); Home educational resources (β = 0.01, p < 0.005).

An additional model included parents' attitudes toward school as a predictor. This factor had a weak but statistically significant effect on students' attitudes toward mathematics (ß = 0.04, p < 0.000). The more parents like the school, the more children perceive the school as a trustworthy environment and show greater openness and receptiveness toward learning.

Grade 8:

Only dominant factors are summarized. Once again, the strongest predictors were Instructional Clarity and Sense of School Belonging. However, the importance of Instructional Clarity increases significantly in eighth grade across all science subjects (except biology) and mathematics. Additionally, in grade 8, School Discipline (ß = 0.03, p < 0.001) and Emphasis on Academic Success (ß = 0.02, p < 0.001) had weak but statistically significant effects on students' attitudes toward mathematics and science.

Grade 8: Key Predictors of Positive Subject Attitudes

Student like	Instructional Clarity	Sense of School Belonging
Mathematics	ß = 0.35, p < 0.001	ß = 0.28, p < 0.001
Biology	ß = 0.27, p < 0.001	ß = 0.45, p < 0.001
Earth Science	ß = 0.51, p < 0.001	ß = 0.19, p < 0.00
Chemistry	ß = 0.48, p < 0.001	ß = 0.03, p < 0.001
Physics	ß = 0.51, p < 0.001	ß = 0.19, p < 0.001

5. Values

The Hidden Power of Values:

What Role Do Values Play in a Student's Academic Success?

The study of values helps education policymakers and researchers better understand the motivations and internal factors that drive student engagement in mathematics and science. Values are directly linked not only to students' motivation and academic achievement, but also to their future career choices. In academic literature, values are typically divided into four dimensions:

- *Intrinsic Value:* A subjective interest in a particular field; for example, how much a student enjoys learning certain subjects;
- *Attainment Value:* The relevance of a subject (or task) to an individual's interests, self-perception, or future goals; for example, the extent to which a student believes they will succeed in these subjects and how important that success is to their identity;
- *Utility Value:* The perceived usefulness of the knowledge gained in a given field for obtaining external rewards (e.g., salary); for example, whether the student believes the content learned in these subjects will be useful outside the classroom;
- *Cost:* The amount of time and effort required to master a particular subject or field. The more a student possesses the first three types of value listed above, the more likely they are to invest effort in learning the subject, and the more likely it is that the benefits will outweigh the costs (i.e., the time and energy spent on learning).

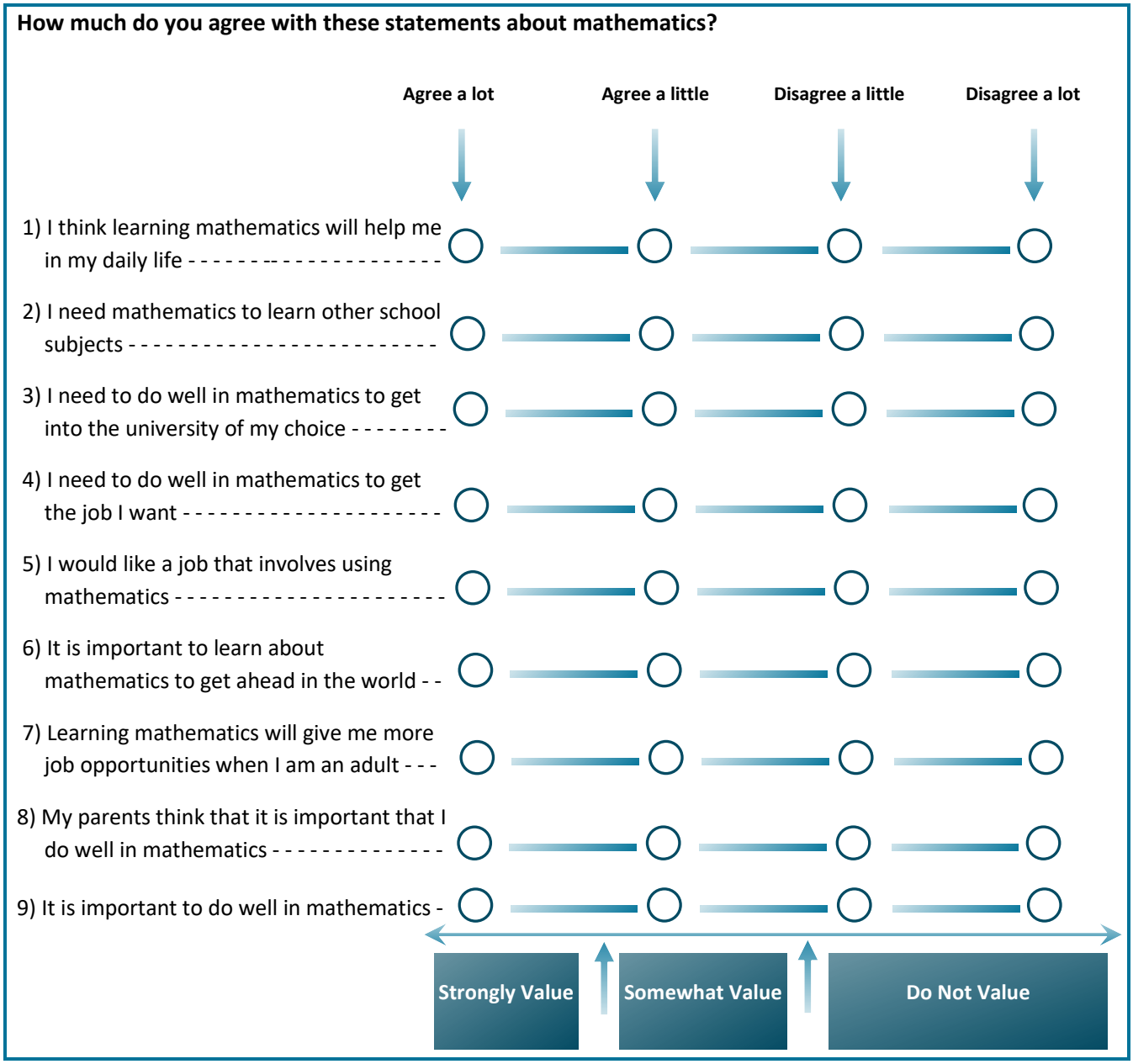
Some researchers combine these components of value into a single construct and measure them as such (Jacobs et al., 2002), while others prefer to assess them separately (Durik et al., 2006; Nagengast et al., 2011).

Values and Academic Achievement

According to the Expectancy-Value Theory (EVT; Eccles, 2009; Eccles et al., 1983), academic achievement in a specific field depends on a combination of the expectation of success and the perceived value (importance) of the task. For a student to invest enough time and intellectual resources into learning mathematics and science, it is essential not only that they believe in their own abilities but also that they consider the effort worthwhile and believe it will lead to corresponding rewards in the future.

Insert: How Students' Perception of the Value of Mathematics and Science is Assessed in TIMSS 2023

Illustration 9. Statements from the Scale9: Students Value Mathematics10



[9] The scale: **Students Value Mathematics** is presented in two variable formats: First, it is a **continuous variable**, with a mean of 10 and a standard deviation of 2. Based on this continuous variable, a second, **categorical variable** is created, dividing the data into three categories: **Strongly Value, Somewhat Value, Do Not Value**.

[10] To assess students' perceived value of science subjects, they were asked to respond to similar questions in relation to science.

Values and Mathematics

In mathematics, attainment value can include both the personal importance of achievement (academic performance) for a student and the personal significance of mathematics (i.e., how closely the field of mathematics aligns with the student's identity or sense of self). As for utility value, it is typically divided into short-term and long-term values:

- **Short-term utility values**: *Using mathematics at school* (how important math is for the student's current and future academic plans), *Using mathematics in everyday life* (how helpful math knowledge is for daily routines and leisure activities), *Using mathematics in social life* (how learning math supports interactions with peers).
- **Long-term utility values**: *Using mathematics in a future job* (how much math knowledge increases the chances of career success); *Using mathematics in general in the future* (whether the student feels math knowledge will be useful in everyday life down the line).

As for *cost*, as one of the dimensions of value, it refers to the time and effort a student must invest to succeed in mathematics, as well as the negative emotions experienced during this process. Interest in exploring the relationship between mathematics-related values and academic achievement is growing in the scientific community. Below, we will discuss empirical evidence from research on these links.

Academic performance in mathematics is closely related to how valuable students perceive the subject to be and whether they see potential for using it in the future—either in their careers or daily life (Greene et al., 1999); Utility value plays a key role in students' motivation to learn mathematics (Mayerhofer et al., 2024). In other words, the more strongly students believe that learning mathematics will help them achieve future goals and career success, the more motivated they are to study. Naturally, this increased motivation raises the likelihood that they will invest effort into learning mathematics and achieve better outcomes, as motivation "pushes us to do something—or not to do it" (Gredler et al., 2004, p. 106). Moreover, students who recognize the practical relevance of the subject tend to maintain stable learning habits and high achievement levels over time (Vansteenkiste et al., 2004). To sum up, there is empirical evidence that students' academic achievement in mathematics is significantly linked to their perception of the subject's practical value and their belief that the time and intellectual effort invested in learning mathematics is not wasted, but rather beneficial for future success.

TIMSS 2023: How Does Perceived Value of Mathematics Relate to Students' Academic Achievement in Mathematics?

In the TIMSS study, this scale is assessed only among eighth-grade students. The data clearly show that students' perception of the value of mathematics is strongly associated with their academic performance. Both Georgian and international data indicate a consistent trend: **the more valuable a student perceives mathematics to be, the higher their average academic achievement**. These findings further highlight the critical importance of not only delivering content knowledge in math education but also demonstrating its relevance and practical applications to boost students' motivation and performance.

Table 11. Perceived Value of Mathematics and Academic Achievement

Mathematics	Strongly Value		Somewhat Value		Do Not Value	
	Students %	Average achievement	Students %	Average achievement	Students %	Average achievement
Georgia's results						
Grade 8	44% (1.2)	479 (3.5)	38% (1.0)	473 (4.1)	19% (0.8)	450 (4.1)
TIMSS International results						
Grade 8	34% (0.1)	494 (0.7)	41% (0.1)	478 (0.6)	24% (0.1)	454 (0.7)

It is worth noting that in Georgia, the percentage of students who perceive mathematics as highly valuable is 10% higher than the international average. At the same time, 19% of Georgian students consider mathematics to be of little value, which is lower than the international figure of 24%.

Values and Science Subjects

In recent years, scientific literature has shown increasing interest—and empirical evidence—regarding the impact of the perceived utility value of science subjects on student motivation (Gaspard et al., 2015; Hulleman et al., 2010, 2017). Research in this area primarily focuses on the link between the perceived utility value of science subjects and academic achievement in these fields (Hulleman et al., 2010; Shechter et al., 2011).

The more utility value students assign to science subjects, the longer they study, the better their academic performance (Vansteenkiste et al., 2004), the more motivated they are, and the higher achievement levels they demonstrate (Rozek et al., 2017). According to a recent study (Rosenzweig et al., 2020), students who perceived physics as useful scored higher on physics exams compared to those who believed they could not apply the subject in real life or academic advancement. Moreover, perceiving science as useful is positively associated with both self-efficacy and a sense of identification with science (Eccles & Wigfield, 2002). In other words, when students believe that learning science will be useful in life, they are more likely to make connections between the subject content and their identity and are more inclined to set long-term goals for success in the field (Stets et al., 2017).

The perception of science's utility value enables students to see its relevance in the context of their future goals (Rozek et al., 2017). Given this, recognizing the value of science subjects is crucial for student engagement and success. Accordingly, researchers have been exploring intervention strategies aimed at helping students see science as more valuable (Acee & Weinstein, 2010; Durik & Harackiewicz, 2007; Harackiewicz et al., 2012; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009).

TIMSS 2023: How Does Perceived Value of Science Subjects Relate to Students' Academic Achievement?

TIMSS data clearly show that students' perception of the value of science subjects is closely linked to their academic performance. Students who perceive these subjects as more valuable generally achieve better results. In Georgia, **51**% of students consider science subjects to be highly valuable, compared to the international average of **36**%. Meanwhile, only **16**% of Georgian students consider learning science to be of little value, while the corresponding international average is **27**%.

Table 12. Perceived Value of Science and Academic Achievement

საბუნებისმეტყველო საგნები	Strongly Value		Somewhat Value		Do Not Value	
	Students %	Average achievement	Students %	Average achievement	Students %	Average achievement
Georgia's results						
Grade 8	51% (1.1)	455 (3.3)	34% (0.9)	450 (4.2)	16% (0.8)	446 (4.1)
TIMSS International results						
Grade 8	36% (0.1)	492 (0.7)	36% (0.1)	475 (0.6)	27% (0.1)	460 (0.8)

In Georgia, the proportion of students who perceive science subjects as valuable is higher than the corresponding international average. However, student achievement is lower across all three groups formed based on their perception of the value of science subjects. These data suggest that perceiving a subject as valuable is not sufficient on its own to improve achievement—there is a need to improve the quality of teaching and learning, as well as to increase access to the resources necessary for science education.

Gender Differences

TIMSS 2023 results show that boys perceive mathematics as a more important subject than girls do; the difference is small but statistically significant. There is also a slight, but statistically significant, gender difference in the perceived importance of science subjects (girls rate science as more important than boys), although the effect size is practically negligible. According to other studies, girls tend to have lower expectations for success in science subjects (Yee & Eccles, 1988).

TIMSS 2023 – Statistical Analysis Results:

Boys (M = 9.82, SD = 2.19) consider mathematics more important than girls (M = 9.54, SD = 2.02). The mean difference (Mean Difference = -0.28) is small but statistically significant ($t(4419) = -4.36$, $p < 0.001$).

A statistically small difference was also observed in the perception of the importance of science subjects: girls (M = 10.28, SD = 1.81) and boys (M = 10.17, SD = 1.84) differ in their perception scores, with girls rating science subjects as more important than boys ($t(4352) = 2.07$, $p = 0.04$). However, the effect size (Cohen's d = 0.063) is very small, indicating a practically insignificant difference.

Girls are less likely to choose science-related subjects as a future career path (Watt et al., 2012), which is often attributed to gender stereotypes prevalent in society. These stereotypes suggest that a girl's primary role is to care for the family or others, which leads many girls to choose socially-oriented professions. On the other hand, gender stereotypes push boys toward professions associated with high income, as they are expected to be family providers. This may explain why men are more often employed in technical and scientific fields (where earnings are generally higher), while women are more represented in social fields (Eccles, 2007). Therefore, it is critically important for both teachers and parents to contribute to shaping children's healthy, stereotype-free attitudes and beliefs. They should instill the idea that girls and boys are equally capable of applying the knowledge gained in science subjects in life and careers, and they should equally encourage both in participating in diverse activities.

Shaping Values: What Factors Determine This?

TIMSS 2023 results clearly highlight the essential role of clarity of instruction in shaping perceptions and attitudes toward mathematics and science subjects. Specifically, the data show that the clearer and more understandable the instruction during the learning process, the stronger students' perception of the value of mathematics. Disruptions in instruction caused by a lack of resources, though relatively minor, negatively affect students' perception of the value of mathematics. Although a school's emphasis on academic success might generally seem beneficial, the findings show that an overly rigid and demanding approach can negatively impact students' attitudes toward the subject. A sense of belonging at school has a positive effect on attitudes toward mathematics, while bullying and disorderly behavior during lessons have a negative impact.

Insert: Multivariate Regression Analysis

Predictors: Clarity of instruction, Instruction Affected by Math Resource Shortage, School Emphasis on Academic Success, Sense of School Belonging, Disorderly Behavior during Math Lessons, Bullying.

Dependent Variable: Perception of the value of mathematics

(1). The results of the regression analysis showed that the model was statistically significant, $F(3, 4238) = 296.6$, $p < 0.001$. The predictors explained 17.4% of the variation in students' perception of the value of mathematics ($R^2 = 0.174$).

Instructional Clarity during math lessons had the most substantial positive impact on students' perception of the value of mathematics ($\beta = 0.41$, $p < 0.001$). Instructional disruption due to lack of resources was also statistically significant but had a smaller effect size ($\beta = 0.03$, $p = 0.03$). The school's emphasis on academic success was negatively associated with students' perception of the value of mathematics ($\beta = -0.05$, $p = 0.003$), indicating that excessive focus on academic performance can harm students' attitudes toward mathematics

(2). An assessment of an additional model, which included more variables, showed that the Sense of School Belonging ($\beta = 0.27$, $p < 0.001$) positively influences students' perception of the value of mathematics, while bullying ($\beta = -0.07$, $p < 0.001$) and disorderly behavior during math lessons are negatively ($\beta = -0.04$, $p = 0.02$) associated with it. In this model, the most influential factor was again clarity of instruction ($\beta = 0.31$, $p < 0.001$). This model explained 22.4% of the variance in the perception of the value of mathematics ($F(4, 4053) = 292.2$, $p < 0.001$).

Recommendations

Beyond academic achievemnts: The Significance of Students' Attitudes and Support Strategies

The value of any study, including TIMSS, goes beyond merely describing and analyzing the current state of school education. Its essential significance lies in the opportunity to develop effective and evidence-based recommendations grounded in the study's findings, aimed at optimizing school practices and supporting teaching and learning processes.

What does TIMSS 2023 teach us, and how can we apply it in practice?

TIMSS 2023 data clearly show that students' individual attitudes play a major role in shaping their academic success. TIMSS teaches us that it is essential for schools, teachers, and those involved in educational policymaking to recognize the importance of regulating and supporting students' attitudes. Alongside strengthening knowledge-based approaches, these attitudes must be taken into account when planning and effectively implementing successful educational interventions. Psychosocial characteristics are not merely accompanying factors in the teaching and learning process—perceiving them as such reflects a superficial interpretation of the mechanisms that determine educational outcomes.

The recommendations presented in this chapter outline specific steps that schools and teachers should take to support students—not only to enhance their emotional well-being and motivation but also to improve academic achievement. These recommendations are based on key factors identified in TIMSS 2023 that have a direct impact on students' school-related attitudes. The recommendations are *grounded in the latest scientific literature and research-based evidence*, which are presented alongside the recommendations themselves. These pieces of evidence serve two important functions: on the one hand, they demonstrate the scientific foundation of the recommendations, enhancing their credibility and legitimacy; on the other hand, they clearly show how the recommendations can be applied in practice and adapted to real educational contexts.

Clarity of Instructions

Clarity of Instruction: *refers to the clear, simple, and organized delivery of new material. Assignments, explained topics, or instructions given by the teacher should be easy for students to understand — clearly formulated, not confusing, and enabling students to grasp exactly what they need to do, why they need to do it, and how they should do it. The teacher uses language that is accessible to students, explains complex topics step by step, and provides additional clarifications when necessary, ensuring that all students can comprehend and engage with the material correctly.*

In recent years, a substantial body of research has accumulated in the scientific literature on factors that contribute to high-quality learning and effective teaching. Among this wealth of empirical data, **clarity of instruction** stands out as a key factor. It involves explaining new material or assignments in a way that is understandable and easily digestible for each student (Arends, 2021). Studies show that the teaching process is particularly effective when it involves clear and effective communication and instruction between teacher and student (Orhan-Goksun & Askim-Kurt, 2017). Other studies in educational psychology also confirm that a structured environment enhances students' **ability to process information**, which, in turn, improves the quality of learning (Bransford et al., 2000).

According to Cognitive Load Theory (Sweller, 1988), when new material is delivered clearly, simply, and in an organized manner, the student's **cognitive resources are fully focused on analyzing the content**. This theory explains why clarity of instruction has such a significant impact on students' attitudes — when students clearly understand an assignment, they can concentrate fully on completing it. But when instructions are unclear, they face a more complex task: first identifying and organizing the assignment's content and structure, and only then attempting to complete it. Naturally, the first scenario involves less stress and a higher likelihood of enjoyment and quality outcomes.

According to TIMSS 2023, students' positive *attitudes toward mathematics and science, as well as learning effectiveness and self-confidence*, significantly increase when the teaching process is clearly structured. Clearly, the teacher plays a crucial role in ensuring the clarity of instruction. It is the teacher's responsibility to formulate assignments, expectations, and learning objectives in a way that is understandable, accessible, and structurally clear for students.

Practical Recommendations for Teachers

What methods and approaches can teachers use to ensure that instructions are clear and promote student confidence and positive attitudes?

Structured Teaching with Visual Materials and Examples

Structured, sequential instruction supported with visual and practical examples enhances students' cognitive engagement and reduces cognitive overload (Sweller, 1988). Mathematics and science often involve abstract and complex concepts; therefore, **visual support for teaching (graphs, diagrams, videos, etc.)** significantly increases students' cognitive efficiency. Graphs, diagrams, videos, and visual aids not only improve cognitive engagement but also spark greater interest in learning, which fosters a positive attitude both toward the subject itself and toward one's own abilities.

It is important to **structure and sequence instruction**. As emphasized in Cognitive Load Theory (Sweller, 1988), students retain concepts better when relevant material is presented in a simple yet well-organized manner. Breaking instructions/assignments into stages, where each activity is clear, manageable, and builds on prior knowledge, gives students a sense of progress and achievement, further strengthening their positive attitudes toward the subject.

When teachers communicate information in language that is easy to understand, use relevant examples, show openness to students' questions, and provide adequate feedback (Chen & Lu, 2022), students **display greater interest and motivation toward learning**. The clearer the instruction, the more **confident** students feel about their ability to learn the subject and/or complete specific tasks, and they become more motivated (Pečiuliauskienė, 2023).

Therefore, tasks and exercises intended for students should be formulated **clearly and simply**, and instructions should be **sequential and logically organized**. If an assignment involves complex concepts, key ideas should be explained in plain language with the support of visual materials and **practical examples.**

Concept Mapping

Concept maps play a particularly important role in delivering learning content in a clear and structured way. A concept map **represents ideas through diagrams and/or networks** (Cheema & Mirza, 2013). Studies (Adah, 2019; Abdulahi, 2016; Cheema & Mirza, 2013) show that concept mapping is a much more effective method of teaching compared to traditional approaches. One study, for example, found that using concept maps in teaching chemistry better predicts growth in student interest and academic achievement than any other method (Adah, 2019; Abdulahi, 2016; Cheema & Mirza, 2013).

The idea of a concept map is based on the notion that nothing in the world exists in isolation; everything is interconnected. Accordingly, new concepts cannot be fully learned without linking them to prior knowledge and to other concepts. Concept maps are a graphical representation of knowledge that simplifies the comprehension of complex concepts and terms and facilitates access to their meaning (Samba & Eriba, 2013), which in turn **positively affects students' attitudes toward the subject and their self-confidence.**

Addressing Individual Needs

Students' motivation, attitudes, and academic achievement are positively influenced by teachers' ability **to tailor the learning environment to each student's needs, apply new and diverse teaching methods, and provide supportive guidance throughout the teaching and learning process** (Bozan & Ekinci, 2020; Sezer, 2018).

Adapting instruction to students' needs and abilities is one of the most important strategies for ensuring effective learning. Learning styles depend not only on cognitive abilities but also on emotional and motivational factors. Some students grasp and complete tasks quickly, while others may need more time or alternative methods to better understand instructions. Therefore, teachers should be prepared to present material in different ways and through multiple methods. It is critical that teachers **consider the individual needs and characteristics** of each student during instruction, explanation, and task assignment (Incik-Yalcin, 2020).

The Scaffolding Method: Assignments Aligned with the Zone of Proximal Development

Addressing individual needs is a broad concept. Selecting tasks **according to the Zone of Proximal Development (ZPD)** is a specific, theory-based strategy within this framework. It involves assigning tasks of optimal difficulty—challenging enough that the student can complete them with minimal support. This is a concrete application of addressing individual needs that focuses on optimizing task difficulty.

According to Bandura's (1997) theory, overcoming challenges has a positive effect on students' self-efficacy. However, encouraging students to engage in specific activities must be aligned with their actual abilities and their **ZPD** (Vygotsky, 1978). **Teachers should carefully select assignments and practical activities according to students' developmental level and prior knowledge**. If students are pushed to complete tasks that are far too difficult for their age or skill level, the likelihood of success is minimal, which may harm their self-confidence and sense of self-efficacy.

Assignments should therefore fall within the student's ZPD (Vygotsky, 1978), **correspond to prior knowledge and practiced skills, and be solvable with slight assistance from a teacher or peer**. It is also critically important for teachers to connect new material to what students already know, **emphasize and repeatedly explain key terms,** use relevant everyday-life examples, and check comprehension through questioning (Mayer & Moreno, 2010). When teachers ensure that every student clearly understands the meaning of new concepts and help them link new material to prior knowledge,

students' academic performance and chances of success increase (Arends, 2021). Students should have opportunities to receive continuous feedback on their work. Feedback should be timely, explanatory, and supportive. Such feedback fosters students' confidence and encourages active participation in the learning process. Above all, students must be given the chance to recognize their mistakes, followed by detailed explanations of why their answers were incorrect and how they can improve.

It is important that teachers avoid fostering competition among students and instead adapt to their individual needs and requirements (Ames, 1992). Strategies for enhancing self-efficacy include **helping students set goals** (Bandura, 1997; Schunk, 1991), **providing timely feedback** (Bandura, 1997), and offering **encouragement** (Siegle & McCoach, 2007), all of which, in turn, contribute to improved achievement levels.

Interactive Lessons and Stimulating Student Participation

Interactive lessons and the stimulation of students' active participation are crucial for ensuring clarity of instruction and sparking interest in learning. The process of delivering instructions should include elements that actively engage students and help them in seeking answers to questions. To this end, it is important to employ group work (solving real or simulated problems collaboratively), discussions and debates (examining thematic assignments and defending reasoned positions), as well as digital platforms and virtual laboratories to increase student engagement.

The approaches of game-based learning and inquiry-/research-based learning, discussed below, are different forms of interactive teaching. Both approaches actively involve students in the learning process: games and projects emphasize creativity, while research-based learning focuses on processes and evidence. In both cases, knowledge acquisition relies on the student's direct experience.

Inquiry- and Research-Based Learning

Laboratory- and practice-oriented teaching methods play a key role in ensuring clarity and effectiveness of instruction.

Students achieve the highest results in science subjects when the learning process takes place in scientific laboratories and includes practical activities (Jamil & Mahmud, 2019). Moreover, the more confident students feel about participating in practical activities and using scientific equipment, the greater their chances of success. Teachers should ensure that students do not feel "alienated" from laboratory tools and equipment, that they learn to use them properly, and that they trust in their own ability to conduct laboratory work. Achieving this requires that science classes be taught in adequately equipped facilities with access to appropriate resources—conditions that often extend beyond teachers' direct responsibilities.

It is important for students to discover knowledge themselves: instead of offering ready-made conclusions, teachers should foster the development of authentic insights. Practical exercises and experiments should be designed to encourage students to reflect on how a particular subject connects to their identity, everyday life, or future aspirations.

Game-Based Learning and Projects

Game-based learning and project-based approaches are effective means of enhancing students' cognitive and emotional engagement and motivation. For example, one study (Baran et al., 2018) found that students who learned Newton's laws through games achieved higher results than those who received the same content through traditional methods. According to the researchers, this

improvement was due to students' enjoyment and the positive emotions generated by the activities, which in turn contributed to higher achievement.

Instructional Stages and Clarity of Instruction

TIMSS 2023 reveals that student achievement declines from the primary to the lower secondary level. This may be linked to the clarity of instruction. According to one study (Arends, 2021), the level of instructional clarity in mathematics is higher at the primary level (70%) compared to ninth grade (52%). It is possible that in ninth grade teachers invest less effort in explaining new material and giving clear instructions, assuming that students no longer need detailed explanations due to prior knowledge and developed skills. However, this assumption is problematic: as students grow older, the complexity of the material also increases, and they actually require even clearer, step-by-step, and logically structured instructions.

Instructional clarity, as TIMSS 2023 demonstrates, directly affects students' attitudes—their interest in the subject, their sense of self-efficacy, and, consequently, their academic performance. It is therefore critically important for teachers to **promptly recognize changes in students' motivation and attitudes and take appropriate measures to address them—whether by engaging parents in discussions, designing enjoyable activities tailored to students' interests, or using other strategies**.

In summary, clarity of instruction and its effective organization minimize cognitive overload and enhance learning motivation. Since students' attitudes are interconnected, the recommendations presented here are also valid for strengthening students' self-confidence, regulating academic emotions, developing positive attitudes toward mathematics and science, and recognizing the importance of learning. For example, recommendations that reinforce students' belief in their abilities foster positive emotions, a sense of interest, and achievement. These, in turn, promote positive dispositions toward the learning process, cultivate the belief that learning is important and challenges are surmountable, and increase students' subjective perception of the relevance of the subject. When students feel capable of completing assignments, they participate in the learning process with higher motivation, experience less fear or stress, and derive greater satisfaction from learning.

Perceived Value of the Subject and Supporting Student Motivation

Delivering instructional material in a clear and structured way not only enhances the effectiveness of knowledge acquisition but also positively influences students' motivation and interest in the subject, ultimately contributing to their academic success. **Students' perception of the subject's importance is another critical prerequisite for motivation.** The teacher's role in shaping this perception is crucial: the more students see that teachers themselves believe in the applied value of their subject, the more students are likely to appreciate the subject and its future applications (Han et al., 2022).

Research (Bathgate & Schunn, 2017) shows that this perception increases significantly when students are given opportunities to participate in scientific activities (such as laboratory work or other formal and informal activities). Such experiences help students see connections between school subjects and real life. This goal can be achieved through various approaches, including **class discussions, presentations, the exchange of advice and information, showing thematic films, and organizing extracurricular activities**. Students may also be assigned homework aimed at exploring and presenting how mathematics is applied in 21st-century contexts. Moreover, it is highly beneficial to provide students with opportunities to meet professionals, scientists, and researchers, so they can better understand the broader role of mathematics and science and hear the perspectives of successful individuals in these fields.

Breaking Gender Stereotypes: The Teacher's Role

A number of studies highlight the negative impact of gender stereotypes on students' self-confidence and attitudes, particularly in mathematics and science. Teachers' professional approach and clarity of instruction play a decisive role in overcoming these stereotypes.

What should teachers do to counteract stereotypes?

Gender stereotypes are a serious challenge, especially in the process of teaching mathematics. To reduce gender gaps in mathematics self-efficacy, it is essential to diminish stereotypes in society (particularly in families and schools) and to **convince students that academic success is determined not by gender but by interest, effort, and perseverance**.

Science subjects are often seen as highly specialized, and school students sometimes fall into the trap of stereotypes that only a select few are capable of mastering them. It is therefore vital for science teachers to direct significant efforts toward cultivating healthier beliefs among students, showing them that success in these fields is **directly proportional to dedication and hard work**.

To strengthen girls' confidence and self-belief, it is important to introduce them to the stories of women who have achieved career success in mathematics, science, and technology (Zeldin & Pajares, 2000). **Example-based learning** can serve as an effective strategy against gender stereotypes: researchers argue that the issue of girls' self-efficacy in mathematics remains relevant because students rarely encounter examples of successful women in this field[11].Teachers can play a decisive role in enhancing girls' self-efficacy in mathematics by creating an environment where they are exposed to role models—successful women in STEM. Teachers should incorporate the stories and biographies of historical and contemporary women scientists into lesson plans, and, where possible, invite female professionals to school as guest speakers. Learning about the experiences of women in STEM can provide girls with the confidence that success in mathematics is equally attainable for them.

Finally, attention must be drawn to the role of **social support**. Since students spend a large portion of their lives in school, creating a friendly, caring, and **supportive environment within classrooms and the school as a whole is critically important**. Teachers' positive attitudes toward students, tolerance of mistakes, and genuine concern for students' learning and development are factors that make the school environment significantly more enjoyable for learners (Juan et al., 2018).

Sense of Belonging to School

> ***Sense of belonging to school:*** *A student's feeling of being accepted, valued, protected, and regarded as a full member of the school community by both teachers and peers. A sense of belonging is fostered through friendly and supportive relationships; the school represents an emotionally safe and stable environment for the student.*

According to TIMSS study, another key factor influencing students' attitudes is their sense of belonging to school. When students feel that school is a safe, friendly, and supportive environment, their self-

[11] Since people are more likely to model the behavior of those similar to themselves (Bandura, 1977), girls are more likely to emulate the actions of women working in mathematics rather than men. Conversely, if they have no such female role models, it is natural that they will not develop an interest in pursuing this field themselves.

esteem, confidence in their abilities, and motivation increase significantly. The school's social network—including teachers, peers, and administration—plays a crucial role in shaping students' emotional well-being. When students feel isolated, their self-confidence declines, affecting both learning outcomes and personal development. A sense of belonging is directly linked to students' self-confidence, which in turn promotes active participation in the learning process and fosters a positive attitude toward acquiring new knowledge (Osterman, 2000). Social psychology theories suggest that individuals' self-confidence and self-efficacy are strengthened when they are in a positive social environment and receive support (Ryan & Deci, 2000).

Thus, schools need to develop initiatives that enhance students' emotional engagement and social support within the school environment. Some of these initiatives are outlined below.

How can we help students feel like full members of the school?

- **Creating an inclusive environment:** Teachers and school staff should demonstrate unconditional positive regard and acceptance toward students. Students should feel accepted as they are, regardless of background, interests, values, etc. This encourages a positive, trustworthy, and safe climate in the school and enhances students' sense of belonging (Thapa et al., 2013). Students should perceive the school not as an "external" or "foreign" institution, but as part of their life and identity; feeling "at home" and engaged with "their own" tasks positively impacts students' psychological well-being, providing them with energy and motivation.
- **Activities for self-expression:** Teachers should plan activities or games that allow students to express themselves. For example, a project like "Who Am I?" enables students to talk about themselves, their interests, and hobbies. Such activities help students see school as a safe environment where their voices are heard, valued, and interests respected. Research shows that these activities also foster tolerance and empathy among students (Wentzel, 2016). Teachers serve as role models, and when they demonstrate respect and acceptance toward all students, children learn to emulate these behaviors, ultimately increasing their sense of belonging as school becomes associated with listening, sharing, and mutual respect.
- **Encouraging teacher–student relationships:** Studies indicate that when students perceive teachers as supportive, warm, and attentive, their sense of belonging increases (Roorda et al., 2011). Teachers should express positive regard toward both the class as a whole and individual student, recognizing their aspirations and strengths and treating them as important individuals. This helps students see school as not only a place for learning but also for social connection, where they are loved and valued for who they are.
- **Involving students in decision-making:** Students should have opportunities to express their opinions, including on improving the school environment. This demonstrates that their ideas are valued and can influence processes. Consequently, students feel they belong to the school community and can feel safe and secure there (Furlong & Christenson, 2006).
- **Field trips and extracurricular activities:** Out-of-school events, excursions, and recreational or fun activities help students associate school not only with structured educational objectives but also with relationships, play, and recreation, thereby enhancing their sense of belonging. Such activities also strengthen interactions among students and between teachers and students, which is critical for fostering belonging.

Research shows that in environments where students feel accepted, respected, and valued as members, bullying incidents are lower (O'Brennan, Bradshaw, & Sawyer, 2009). Experiences of bullying negatively impact students' psycho-social development and are perceived as neglect or indifference by the school, reducing their sense of belonging (Espelage & Swearer, 2010).

Bullying

Bullying in school: *Targeted and repeated aggressive actions toward a student or group of students aimed at humiliation, intimidation, or exclusion. Bullying usually involves a power imbalance, where the aggressor(s) possess physical, social, or emotional advantage over the victim. Bullying harms not only the victim's emotional and mental well-being but also the overall school climate, disrupting learning and undermining trust.*

Bullying is a significant barrier to students' school engagement and psychological well-being. Schools need effective mechanisms for bullying prevention and intervention to create an environment where students feel safe and connected to the school community. Ensuring a safe and supportive learning environment for students is impossible without systematic bullying prevention. To reduce the prevalence of bullying while simultaneously fostering students' social-emotional skills, coordinated and multifaceted actions are required, addressing both policy and pedagogical practices. How can this goal be achieved?

- First of all, schools need a **clear and effective action plan for bullying prevention**. This plan should define what constitutes bullying, how to identify and respond to it, and assign responsibilities. Successful implementation requires **active communication with all school members**—teachers, students, and parents. **Regular training and discussions** should be implemented to increase awareness of bullying and promote positive relationships.
- The school's general anti-violence policy and internal regulations should explicitly oppose any form of violent behavior. **Monitoring the social climate** is essential, using anonymous surveys or research to assess the prevalence of bullying. Results can guide targeted interventions.
- While reducing bullying prevalence, schools should also focus on improving students' **social-emotional skills**, which help them cope with bullying (Oliveira et al., 2018). Skills such as **empathy, emotional regulation, cooperation, and responsibility** are directly linked to students' well-being and academic success. Social-emotional learning (SEL) elements should be integrated into daily teaching, for example, lessons on "How to handle conflict" or "Recognizing and expressing emotions," as well as group activities fostering supportive behaviors.
- High **self-esteem** is associated with lower bullying rates. **Improved self-esteem can act as a protective factor against the negative effects of bullying.** Supporting students' self-esteem may reduce their likelihood of becoming victims and minimize bullying's impact on academic performance. Similarly, reducing bullying prevalence may allow students with healthy self-esteem to achieve success with fewer obstacles.
- **It is important to understand teachers' role**: Teachers must play a critical role as **models of emotional support and positive relationships.** Their attitudes toward students, including in challenging or conflict situations, significantly shape the school's social climate. Consistent, clear, and empathetic instruction not only facilitates learning but also creates a safe, predictable environment, particularly important for vulnerable groups and potential bullying targets. **Rising teachers' awareness is essential -** they must be aware of students' social-emotional needs and coping strategies.
- **Encouraging prosocial behavior**: Teachers should praise prosocial behaviors, constructive conflict resolution, and courteous actions. According to Bandura, children imitate rewarded behaviors, so promoting these behaviors can encourage others to follow suit. Teachers may organize presentations, discussions, or class sessions on bullying to help students arrive at the conclusion that aggression toward others is unacceptable.
- **Supervision of play/recreational areas**: Most aggressive incidents occur outside class, during breaks when students have more freedom and less supervision, since, during this period, students have more freedom and are less supervised by staff (teachers).Designated supervisors

in play and recreational areas can reduce bullying incidents and intervene when necessary to explain why aggression is unacceptable.

- **Organizing meetings with parents** – it is important to engage parent. they should be informed about their child's academic and emotional challenges to jointly plan interventions. Teachers can also gather information on students' traits, interests, and preferences to tailor approaches for individual students (Ttofi & Farrington, 2010; Kyriakides & Creemers, 2013).

Effective bullying prevention requires a synchronized approach that combines structural and social-emotional initiatives, transforming school culture into an inclusive, safe, and supportive environment, which positively impacts students' achievements and well-being.

Regulating Academic Expectations

A school's focus on academic success and its academic expectations describe how high the school's standards and goals are regarding learning outcomes and how much the school community (teachers, administration, parents) expects students to achieve academic progress.

***Academic expectations** involve regularly expressed expectations for high-quality learning and effort. **A school's focus on academic success** means prioritizing student achievement and creating an environment that supports it; recognizing and rewarding academic success; and directing resources, time, and strategies toward helping students reach their full potential.*

TIMSS 2023 shows that excessive expectations and an overemphasis on academic success can have potentially harmful effects. Schools need to examine and **adjust their approach to academic expectations** to avoid placing undue pressure on students. Students who constantly experience excessive demands for academic success may exhibit higher levels of anxiety, lower self-efficacy, and disengagement from the learning process (Schunk & Pajares, 2009). In such an environment, they may not only lose confidence but also develop a "fear of failure," which hinders the active acquisition of new skills and knowledge. High expectations that do not align with students' individual abilities and needs often lead to serious psychological pressure, stress, and decreased motivation (Eccles & Wigfield, 2002).

While encouragement and promotion of academic progress are vital, **excessive expectations and pressure can backfire.**

Therefore, schools should create a more balanced learning environment. It is important for students to experience motivation to strive for progress, but this should be aligned with their individual abilities and needs. In this regard, the implementation of flexible assessment systems and a focus not only on outcomes but also on the learning process is crucial, as it supports students' personal growth and psychological well-being.

The Role of the Family

Recent educational research emphasizes that students' academic achievements, attitudes, and overall development depend not only on school but also on the family environment. Research (Rozek et al., 2015) shows that **parents play a critical role in shaping students' value systems and achievements.** One study conducted in Canada with around 760 students (Chouinard et al., 2007) found that parents have a greater influence on students' values and perception of a subject's utility, whereas teachers have a greater influence on students' self-efficacy. In other words, if parents perceive mathematics as a subject with high practical value that contributes to personal development and success, students are more likely to recognize the importance of mathematics and approach learning it seriously. Meanwhile, teachers influence students' self-confidence and beliefs about their abilities through rewards, praise, high grades, or simply positive interactions. Therefore, it is *highly beneficial for teachers to plan meetings with parents to explain their role in shaping attitudes toward mathematics and science and, if necessary, clarify the practical importance of these subjects so that parents can reinforce these values in their children.*

By creating an encouraging and rewarding environment, using meaningful assessments, and teaching strategies to overcome challenges, parents help children build a sense of competence (Sha et al., 2016). Parents influence children's self-efficacy through verbal reinforcement of skills and abilities, setting optimal expectations, encouraging participation in science activities, and more (Bouchey & Harter, 2005; Rice et al., 2013). Therefore, it is **beneficial for teachers to maintain frequent communication with parents to explain the critical role they play in their children's success.**

Family support is particularly important in the context of reducing socioeconomic inequalities. Increasing parents' access to educational resources helps reduce educational disparities and improve academic outcomes for children from low-income families (Heckman & Masterov, 2007). Accordingly, policymakers and education planners can use these insights to develop initiatives that ensure family engagement in school life, dissemination of educational resources, and parental education to support children's learning. Thus, improving the education system is not limited to school reforms alone.

Active family participation in a child's education can take various forms, including **providing academic support, ensuring access to learning materials, and promoting educational values.** Research shows that students whose families prioritize education achieve better outcomes both academically and in life (Jeynes, 2005). Recognizing the importance of family support is essential in planning policies and developing educational programs to ensure children receive a comprehensive and sustainable education.

References

ACEE, T. W., & WEINSTEIN, C. E. (2010). Effects of a value-reappraisal intervention on statistics students' motivation and performance. *The Journal of Experimental Education, 78*(4), 487–512. https://doi.org/10.1080/00220970903352753

ADELSON, J. L., & MCCOACH, D. B. (2011). Development and psychometric properties of the Math and Me Survey: Measuring third through sixth graders' attitudes toward mathematics. *Measurement and Evaluation in Counseling and Development, 44*(4), 225–247. https://doi.org/10.1177/0748175611418522

ADELSON, J. L., & MCCOACH, D. B. (2011). Development and psychometric properties of the math and me survey: Measuring third through sixth graders' attitudes toward mathematics. *Measurement and Evaluation in Counseling and Development, 44*(4), 225-247

AKINSOLA, M. K., & OLOWOJAIYE, F. B. (2008). Teacher instructional methods and student attitudes towards mathematics. *International Electronic Journal of Mathematics Education, 3*(1), 60-73

ÁLVAREZ, C., & SZÜCS, D. (2023). The relation of school achievement with self-esteem and bullying in Chilean children. Current Psychology, 42(27), 23480-23494.

ÁLVAREZ, C., & SZÜCS, D. (2023). The relation of school achievement with self-esteem and bullying in Chilean children. *Current Psychology, 42*(27), 23480-23494

AMES, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261

ANDERMAN, L. H. (2002). School effects on psychological outcomes during adolescence. *Journal of Educational Psychology, 94*(4), 795–809. https://doi.org/10.1037/0022-0663.94.4.795

ARENDS, F. (2021). Help them understand: The importance of instructional clarity in teaching and learning. *Human Science Research Council Reviews, 19*(2), 33–34. https://ln.run/kipMS

ARENDS, F., & VISSER, M. (2019). The contribution of South African teachers to students' sense of belonging and mathematics achievement: Students' perspective from the 2015 Trends in International Mathematics and Science Study. *South African Journal of Childhood Education, 9*(1), a697. https://doi.org/10.4102/sajce.v9i1.697

BANDURA, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall

BANDURA, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman

BARAN, M., MASKAN, A., & YAŞAR, Ş. (2018). Learning physics through project-based learning game techniques. *International Journal of Instruction, 11*(2), 221–234. https://doi.org/10.12973/iji.2018.11215a

BARTH, J., JOHNSTON, C., & ROSS, S. M. (2011). The effects of inquiry-based science instruction on science achievement and interest. *Journal of Science Education and Technology, 20*(1), 45–55

BATHGATE, M., & SCHUNN, C. (2017). The psychological characteristics of experiences that influence science motivation and content knowledge. International Journal of Science Education, 39(17), 2402-2432

BAUMEISTER, R. F., & LEARY, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

BEGEN, F. M., & TURNER-COBB, J. M. (2015). Benefits of belonging: Experimental manipulation of social inclusion to enhance psychological and physiological health parameters. *Psychology & Health, 30*(5), 568–582.

https://doi.org/10.1080/08870446.2014.991734
BERGER, C., & CARAVITA, S. C. (2016). Why do early adolescents bully? Exploring the influence of prestige norms on social and psychological motives to bully. *Journal of Adolescence, 46*, 45–56

BOUCHARD, K. L., & BERG, D. H. (2017). Students' school belonging: Juxtaposing the perspectives of teachers and students in the late elementary school years (Grades 4–8). *School Community Journal, 27*(1), 107–136. https://files.eric.ed.gov/fulltext/EJ1146469.pdf

BOUCHEY, H. A., & HARTER, S. (2005). Reflected appraisals, academic self-perceptions, and math/science performance during early adolescence. Journal of Educational Psychology, 97(4), 673.

BRANSFORD, J. D., BROWN, A. L., & COCKING, R. R. (2000). *How people learn: Brain, mind, experience, and school* (Expanded ed). National Academy Press

BRITNER, S. L., & PAJARES, F. (2001). Self-efficacy beliefs, motivation, race, and gender in middle school science. *Journal of Women and Minorities in Science and Engineering, 7*(4)

BRITNER, S. L., & PAJARES, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43*(5), 485–499. https://doi.org/10.1002/tea.20131

BROWN, M., BROWN, P., & BIBBY, T. (2008). "I would rather die": Attitudes of 16-year-olds towards mathematics. *Research in Mathematics Education, 10*(1), 3–18. https://doi.org/10.1080/14794800801915814

BUTLER, D., KIFT, S., & CAMPBELL, M. (2009). Cyber bullying in schools and the law: Is there an effective means of addressing the power imbalance? *eLaw Journal, 16*, 84

CHANG, C. S., LIU, E. Z. F., SUNG, H. Y., LIN, C. H., CHEN, N. S., & CHENG, S. S. (2014). Effects of online college student's Internet self-efficacy on learning motivation and performance. Innovations in Education and Teaching International, 51(4), 366-377.

CHEEMA, A. B., & MIRZA, M. S. (2013). Effect of concept mapping on students' academic achievement. Journal of Research & Reflections in Education (JRRE), 7(2).

CHEEMA, A. B., & MIRZA, M. S. (2013). Effect of Concept Mapping On Students' Academic Achievement. Journal of Research & Reflections in Education (JRRE), 7(2)

CHEN, J., & LU, H. (2022). Evaluation method of classroom teaching effect under intelligent teaching mode. Mobile Networks and Applications, 27(3), 1262-1270

CHEN, P. P. (2003). Exploring the accuracy and predictability of the self-efficacy beliefs of seventh-grade mathematics students. Learning and Individual Differences, 14(1), 77-90.

CHEN, W.-W., LAM, U. F., & ZHANG, J. (2015). It feels good to learn where I belong: School belonging, academic emotions, and academic achievement in adolescents. School Psychology International, 36(4), 393–409. https://doi.org/10.1177/0143034315589649

CHOUINARD, R., KARSENTI, T., & ROY, N. (2007). Relations among competence beliefs, utility value, achievement goals, and effort in mathematics. British Journal of Educational Psychology, 77(3), 501-517.

CREEMERS, B., KYRIAKIDES, L., ANTONIOU, P., CREEMERS, B., KYRIAKIDES, L., & ANTONIOU, P. (2013). Towards the development of a dynamic approach to teacher professional development. Teacher Professional Development for Improving Quality of Teaching, 3-11.

CRICK, N. R., & GROTPETER, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. Child development, 66(3), 710-722

DECI, E. L., & RYAN, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.

DURIK, A. M., & HARACKIEWICZ, J. M. (2007). Different strokes for different folks: How individual interest moderates the effects of situational factors on task interest. *Journal of Educational Psychology*, *99*(3), 597–610. https://doi.org/10.1037/0022-0663.99.3.597

ECCLES, J. S. (1983). Expectancies, values, and academic behaviors. In Achievement and achievement motives (pp. 75-146). Freeman.

ECCLES, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, *44*(2), 78–89. https://doi.org/10.1080/00461520902832368

ECCLES, J. S., & WIGFIELD, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109–132. https://doi.org/10.1146/annurev.psych.53.100901.135153

ECCLES, J. S., ADLER, T. F., FUTTERMAN, R., GOFF, S. B., KACZALA, C. M., MEECE, J. L., & MIDGLEY, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). San Francisco, CA: W. H. Freeman.

FENNEMA, E., & SHERMAN, J. A. (1977). Sex-related differences in mathematics achievement and related factors: A further study. *Journal for Research in Mathematics Education*, *8*(3), 189–203. https://doi.org/10.2307/748997

FURLONG, M. J., & CHRISTENSON, S. L. (2008). Engaging students at school and with learning: A relevant construct for all students. Psychology in the Schools, 45(5), 365-368.

GALAMBOS, N. L. (2004). *Gender and gender role development in adolescence*. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 233–262). Wiley.

GASPARD, H., DICKE, A.-L., FLUNGER, B., BRISSON, B. M., HÄFNER, I., NAGENGAST, B., & TRAUTWEIN, U. (2015). Fostering adolescents' value beliefs for mathematics with a relevance intervention in the classroom. *Developmental Psychology*, *51*(9), 1226–1240. https://doi.org/10.1037/dev0000028

GLASSER, W. (1986). *Control theory in the classroom*. Harper & Row.

GOODENOW, C. (1993). *Classroom belonging among early adolescent students: Relationships to motivation and achievement*. The Journal of Early Adolescence, 13(1), 21–43. https://doi.org/10.1177/0272431693013001002

GOODENOW, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. *The Journal of Early Adolescence*, 13(1), 21–43. https://doi.org/10.1177/0272431693013001002

GREDLER, M. E., BROUSSARD, S. C., & GARRISON, M. E. B. (2004). Motivation: The attribute that moves us to do or not to do something. In *Motivation: A literature review*. Retrieved from https://www.academia.edu/19645582/Motivation_A_literature_review

GREDLER, M., & SHIELDS, C. (2004). Does no one read Vygotsky's words? Commentary on Glassman. Educational Researcher, 33(2), 21-25.

GREENE, B. A., DEBACKER, T. K., RAVINDRAN, B., & KROWS, A. J. (1999). Goals, values, and beliefs as predictors of achievement and effort in high school mathematics classes. *Sex Roles*, *40*(5–6), 421–458.

HANNULA, M. S., MAIJALA, H., & PEHKONEN, E. (2004). Development of understanding and self-confidence in mathematics; Grades 5–8. In M. J. Høines & A. B. Fuglestad (Eds.), *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 3, pp. 17–24). Bergen University College.

HARACKIEWICZ, J. M., CANNING, E. A., TIBBETTS, Y., PRINISKI, S. J., & HYDE, J. S. (2016). Closing achievement gaps with a utility-value intervention: Disentangling race and social class. Journal of personality and social psychology, 111(5), 745

HASLAM, S. A., JETTEN, J., POSTMES, T., & HASLAM, C. (2010). *Social identity, health and well-being: An emerging agenda for applied psychology*. Applied Psychology, 58(1), 1–23. https://doi.org/10.1111/j.1464-0597.2008.00379.x

HECKMAN, J. J., & MASTEROV, D. V. (2007). The productivity argument for investing in young children. *Review of Agricultural Economics, 29*(3), 446–493.

HUGHES, J. N., IM, M. H., & WEHRLY, S. E. (2014). *Effect of peer nominations of teacher–student support at individual and classroom levels on social and academic outcomes*. *Journal of School Psychology*, 52(3), 309–322. https://doi.org/10.1016/j.jsp.2013.12.004

HULLEMAN, C. S., & HARACKIEWICZ, J. M. (2009). Promoting interest and performance in high school science classes. *Science*, *326*(5958), 1410–1412. https://doi.org/10.1126/science.1177067

HULLEMAN, C. S., GODES, O., HENDRICKS, B. L., & HARACKIEWICZ, J. M. (2010). Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology*, *102*(4), 880–895. https://doi.org/10.1037/a0019506

HULLEMAN, C. S., KOSOVICH, J. J., BARRON, K. E., & DANIEL, D. B. (2017). Making connections: Replicating and extending the utility value intervention in the classroom. *Journal of Educational Psychology*, *109*(3), 387–404. https://doi.org/10.1037/edu0000146

İNCIK YALÇIN, E. (2020). Investigation of the relationship between teachers' lifelong learning tendencies and 21st century teacher skills. Bolu Abant Izzet Baysal University Journal of Faculty of Education, 20(2), 1099-1112

JAMES, W. (1890). *The principles of psychology* (Vol. 1). Henry Holt and Company.

JAMIL, N. L., & MAHMUD, S. N. D. (2019). Self-efficacy relationship on science achievement amongst national secondary school students. Creative Education, 10(11), 2509-2527

JANSEN, M., SCHERER, R., & SCHROEDERS, U. (2015). Students' self-concept and self-efficacy in the sciences: Differential relations to antecedents and educational outcomes. *Contemporary Educational Psychology*, 41, 13–24. https://doi.org/10.1016/j.cedpsych.2014.11.002

JEYNES, W. H. (2015). A meta-analysis on the factors that best reduce the achievement gap. Education and Urban Society, 47(5), 523-554.

JOSEPH, G. (2013). A study on school factors affecting students' attitudes towards learning mathematics in the Community Secondary Schools in Tanzania, The Case of Bukoba Municipal Council in Kagera Region (Doctoral dissertation, The Open University of Tanzania)

KAPUCU, S., & BAHÇIVAN, E. (2015). High school students' scientific epistemological beliefs, self-efficacy in learning physics, and attitudes toward physics: A structural equation model. Research in Science & Technological Education, 33(2), 252-267

KNIFSEND, C. A., & GRAHAM, S. (2012). *Too much of a good thing? How breadth of extracurricular participation relates to school-related affect and academic outcomes during adolescence*. Journal of Youth and Adolescence, 41(3), 379–389. https://doi.org/10.1007/s10964-011-9737-4

KORPERSHOEK, H., CANRINUS, E. T., FOKKENS-BRUINSMA, M., & DE BOER, H. (2019). *The relationships between school belonging and students' motivational, social-emotional, behavioural, and academic outcomes in secondary education: A meta-analytic review*. Research Papers in Education, 35(6), 641–680. https://doi.org/10.1080/02671522.2019.1615116

LARSON, L., & DECHURCH, L. A. (2020). **Leading teams in the digital age: Four perspectives on technology and what they mean for leading teams**. *The Leadership Quarterly*, *31*(1), 101377.

LAU, S., & ROESER, R. W. (2002). Cognitive abilities and motivational processes in high school students' situational engagement and achievement in science. *Educational Assessment*, 8(2), 139–162. https://doi.org/10.1207/S15326977EA0802_04

LIU, X., & KOIRALA, H. (2009). The effect of mathematics self-efficacy on mathematics achievement of high school students.

MA, X. (1997). Reciprocal relationships between attitude toward mathematics and achievement in mathematics. *The Journal of Educational Research*, *90*(4), 221–229.

MA, X. (2003). *Sense of belonging to school: Can schools make a difference?* The Journal of Educational Research, 96(6), 340–349. https://doi.org/10.1080/00220670309596617

MALONEY, T., & MATTHEWS, J. S. (2020). Teacher care and students' sense of connectedness in the urban mathematics classroom. *Journal for Research in Mathematics Education*, 51(4), 399–432. https://doi.org/10.5951/jresematheduc-2020-0044

MALTESE, A. V., & TAI, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education, 95*(5), 877–907. https://doi.org/10.1002/sce.20441

MASLOW, A. H. (1943). *A theory of human motivation*. Psychological Review, 50(4), 370–396. https://doi.org/10.1037/h0054346

MASLOW, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396. https://doi.org/10.1037/h0054346

MASLOW, A. H. (1954). *Motivation and personality*. Harper & Row.

MATA, M. D. L., MONTEIRO, V., & PEIXOTO, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *Child development research*, *2012*(1), 876028.

MAYER, R. E., & MORENO, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 43–52. https://doi.org/10.1207/S15326985EP3801_6

MAYERHOFER, M., LÜFTENEGGER, M., & EICHMAIR, M. (2024). The development of mathematics expectancy–value profiles during the secondary–tertiary transition into STEM fields. *International Journal of STEM Education*, *11*(1), 31. https://doi.org/10.1186/s40594-024-00491-6

MAZANA, Y. M., SUERO MONTERO, C., & OLIFAGE, C. R. (2019). Investigating students' attitude towards learning mathematics

MENTING, A. T. A., VAN LIER, P. A. C., & KOOT, H. M. (2011). **Language skills, peer rejection, and the development of externalizing behavior from kindergarten to fourth grade**. *Journal of Child Psychology and Psychiatry*, *52*(1), 72–79. https://doi.org/10.1111/j.1469-7610.2010.02279.x

MOHAMED, L., & WAHEED, H. (2011). Secondary students' attitude towards mathematics in a selected school of Maldives. International Journal of Humanities and Social Science, 1(15), 277-281

MOZAHEM, N. A. (2021). Gender, education, and career in the Arab world: A literature review. Research in Education, 111(1), 141-163.

MULLIS, I. V., MARTIN, M. O., FOY, P., & ARORA, A. (2012). TIMSS 2011 international results in mathematics. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands

MUTAI, K. J. (2011). Attitudes towards learning and performance in mathematics among students in selected secondary schools in Bureti district, Kenya. Unpublished Masters Dissertation

NEWMAN, B. M., LOHMAN, B. J., & NEWMAN, P. R. (2007). *Peer group membership and a sense of belonging: Their relationship to adolescent behavior problems*. Adolescence, 42(166), 241–263.

NGUSSA, B. M., & MBUTI, E. E. (2017). The influence of humour on learners' attitude and mathematics achievement: A case of secondary schools in Arusha City, Tanzania. Journal of Educational Research, 2(3), 170-181

NICHOLS, S. L. (2006). *Teachers' and students' beliefs about student belonging in one middle school*. The Elementary School Journal, 106(3), 255–271. https://doi.org/10.1086/501486

NICHOLS, S. L., & GOOD, T. L. (2004). *America's teenagers—myths and realities: Media images, schooling, and the social costs of careless indifference*. Routledge.

O'BRENNAN, L. M., BRADSHAW, C. P., & SAWYER, A. L. (2009). Examining developmental differences in the social-emotional problems among frequent bullies, victims, and bully/victims. Psychology in the Schools, 46(2), 100-115.

OECD. (2016). *PISA 2015 results (Volume III): Students' well-being*. OECD Publishing. https://doi.org/10.1787/9789264273856-en

OECD. (2017). *PISA 2015 results (Volume III): Students' well-being*. OECD Publishing. https://doi.org/10.1787/9789264273856-en

OLWEUS, D. (2013). *School bullying: Development and some important challenges*. *Annual Review of Clinical Psychology*, *9*, 75–103. https://doi.org/10.1146/annurev-clinpsy-050212-185516

ORHAN-GÖKSUN, D., & AŞKIM KURT, A. (2017). The relationship between pre-service teachers' use of 21st century learner skills and 21st century teacher skills. *Eğitim ve Bilim (Education and Science)*, *42*(190), 107–130.

OSTERMAN, K. F. (2000). Students' need for belonging in the school community. Review of educational research, 70(3), 323-367

Ozkal, N. (2019). Relationships between self-efficacy beliefs, engagement, and academic performance in math lessons. Kıbrıslı Eğitim Bilimleri Dergisi, 14(2), 190-200.

Pajares, F., & Schunk, D. H. (2001). Self-beliefs and school success: Self-efficacy, self-concept, and school achievement. Perception, 11(2), 239-266

Parker, S. K., & Grote, G. (2020). **Automation, algorithms, and beyond: Why work design matters more than ever in a digital world**. *Applied Psychology*, *69*(3), 479–525. https://doi.org/10.1111/apps.12241

Pečiuliauskienė, P. (2023). Instructional clarity in physics lessons: Students' motivation and self-confidence. Cogent Education, 10(2), 2236463.

Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 259–282). Springer. https://doi.org/10.1007/978-1-4614-2018-7_12

Phillips, D. A., & Zimmerman, M. (1990). The developmental course of perceived competence and incompetence among competent children.

Ponzo, M. (2013). Does bullying reduce educational achievement? An evaluation using matching estimators. Journal of Policy Modeling, 35(6), 1057-1078.

Roorda, D. L., Koomen, H. M., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. Review of Educational Research, 81(4), 493-529.

Rosenzweig, E. Q., Wigfield, A., & Hulleman, C. S. (2020). More useful or not so bad? Examining the effects of utility value and cost reduction interventions in college physics. Journal of Educational Psychology, 112(1), 166

Rozek, C. S., Hyde, J. S., Svoboda, R. C., Hulleman, C. S., & Harackiewicz, J. M. (2015). Gender differences in the effects of a utility-value intervention to help parents motivate adolescents in mathematics and science. Journal of Educational Psychology, 107(1), 195.

ROZEK, C. S., SVOBODA, R. C., HARACKIEWICZ, J. M., HULLEMAN, C. S., & HYDE, J. S. (2017). Utility-value intervention with parents increases students' STEM preparation and career pursuit. *Proceedings of the National Academy of Sciences*, *114*(5), 909–914. https://doi.org/10.1073/pnas.1607386114

RUSTEHOLZ, G., MEDIAVILLA, M., & PIRES JIMÉNEZ, L. (2021). Impact of bullying on academic performance. A case study for the Community of Madrid. IEB Working Paper 2021/01.

SADKER, M., & SADKER, D. (1994). Missing in interaction. Failing at fairness: How America's schools cheat girls.

SAMBA, R. M. O., & ERIBA, J. O. (2012). Innovative approaches in teaching difficult science concepts. Markurdi: Destiny ventures

SCHUNK, D. H. (1991). Self-efficacy and academic motivation. Educational Psychologist, 26(3-4), 207-231.

SCHUNK, D. H., & MEECE, L. (2006). SELF-EFFICACY DEVELOPMENT IN. Self-efficacy beliefs of adolescents, 71

SCHUNK, D. H., & PAJARES, F. (2007). Self-efficacy in education. In *Handbook of motivation at school*. Routledge. https://doi.org/10.4324/9780203879498

SCHUNK, D. H., & PAJARES, F. (2009). Self-Efficacy Theory. In Handbook of Motivation at School (pp. 49-68). Routledge.

SHECHTER, B., DURIK, A. M., MIYAMOTO, Y., & HARACKIEWICZ, J. M. (2011). The role of utility value in achievement behavior: The importance of culture. *Personality and Social Psychology Bulletin*, *37*(3), 303–317. https://doi.org/10.1177/0146167210396380

SIEGLE, D., & MCCOACH, D. B. (2007). Increasing student mathematics self-efficacy through teacher training. *Journal of Advanced Academics*, *18*(2), 278–312. https://eric.ed.gov/?id=EJ767452

SKAALVIK, E. M., & SKAALVIK, S. (2006). Self-concept and self-efficacy in mathematics: Relation with mathematics motivation and achievement. The Concept of Self in Education, Family, and Sports, 51-74.

STETS, J. E., BRENNER, P. S., BURKE, P. J., & SERPE, R. T. (2017). The science identity and entering a science occupation. *Social Science Research*, *64*, 1–14.

SWEARER, S. M., ESPELAGE, D. L., VAILLANCOURT, T., & HYMEL, S. (2010). What can be done about school bullying? Linking research to educational practice. Educational Researcher, 39(1), 38-47.

SWELLER, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

SYYEDA, F. (2016). Understanding attitudes towards mathematics (ATM) using a multimodal model: An exploratory case study with secondary school children in England

TAHAR, N. F., ISMAIL, Z., ZAMANI, N. D., & ADNAN, N. (2010). Students' attitude toward mathematics: The use of factor analysis in determining the criteria. Procedia-Social and Behavioral Sciences, 8, 476-481.

THAPA, A., COHEN, J., GUFFEY, S., & HIGGINS-D'ALESSANDRO, A. (2013). A review of school climate research. Review of educational research, 83(3), 357-385

TODOR, I. (2014). Investigating "the old stereotype" about boys/girls and mathematics: Gender differences in implicit theory of intelligence and mathematics self-efficacy beliefs. *Procedia-Social and Behavioral Sciences*, *159*, 319-323.

TROOP-GORDON, W. (2017). Peer victimization in adolescence: The nature, progression, and consequences of being bullied within a developmental context. Journal of adolescence, 55, 116-128

TTOFI, M. M., & FARRINGTON, D. P. (2010). School bullying: Risk factors, theories and interventions. In Handbook on crime (pp. 427-457). Willan.

VALENTINE, J. C., DUBOIS, D. L., & COOPER, H. (2004). The relation between self-beliefs and academic achievement: A meta-analytic review. *Educational Psychologist*, 39(2), 111–133. https://doi.org/10.1207/s15326985ep3902_3

VANSTEENKISTE, M., SIMONS, J., LENS, W., SHELDON, K. M., & DECI, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology*, *87*(2), 246–260. https://doi.org/10.1037/0022-3514.87.2.246

VANSTEENKISTE, M., SIMONS, J., LENS, W., SHELDON, K. M., & DECI, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology*, *87*(2), 246–260. https://doi.org/10.1037/0022-3514.87.2.246

VRONTIS, D., & CHRISTOFI, M. (2021). R&D internationalization and innovation: A systematic review, integrative framework and future research directions. Journal of Business Research, 128, 812-823

WANG, J., IANNOTTI, R. J., & NANSEL, T. R. (2009). School bullying among adolescents in the United States: Physical, verbal, relational, and cyber. *Journal of Adolescent Health*, *45*(4), 368–375. https://doi.org/10.1016/j.jadohealth.2009.03.021

WATT, H. M., SHAPKA, J. D., MORRIS, Z. A., DURIK, A. M., KEATING, D. P., & ECCLES, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: a comparison of samples from Australia, Canada, and the United States. Developmental psychology, 48(6), 1594

WENTZEL, K. R. (2016). Teacher-student relationships. In Handbook of motivation at school (pp. 211-230). Routledge.

WILLMS, J. D. (2000). *Student engagement at school: A sense of belonging and participation* (Results from PISA 2000). Organisation for Economic Co-operation and Development (OECD).

WINNAAR, L., ARENDS, F., & BEKU, U. (2018). Reducing bullying in schools by focusing on school climate and school socio-economic status. South African Journal of Education, 38(1)

YAGAN, S. A. (2021). The relationships between instructional clarity, classroom management and mathematics achievement: Mediator role of attitudes towards mathematics. University of South Florida (USF) M3 Publishing, 32021), 7

YEE, D. K., & ECCLES, J. S. (1988). Parent perceptions and attributions for children's math achievement. Sex roles, 19(5), 317-333

ZELDIN, A. L., & PAJARES, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, 37(1), 215–246. https://doi.org/10.3102/00028312037001215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