

# Learning motivation in the context of mathematics among 6–13-year-old students: A systematic literature review of concepts and instruments

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## Summary

### Introduction

Motivation can be defined as an internal state that prompts, maintains, and directs student behaviour (Ryan & Deci, 2000; Schunk et al., 2014). It is triggered in response to an internally perceived need or external stimulus (Jansen et al., 2022). Rather than remaining constant, motivation varies depending on the type of task a student undertakes, as well as the educational level and the student's developmental stage.

Students tend to feel more competent in subjects in which they perform well and value those subjects more highly (Denissen et al., 2007). Understanding the factors that shape motivation is thus essential. While some subjects are easier to master, others require greater effort; mathematics is generally perceived as particularly challenging (Ashcraft & Krause, 2007). As a core subject taught at all educational levels, gaps in knowledge from primary school can often make learning more demanding due to the hierarchical nature of mathematics, where new concepts build on prior understanding (Jõgi et al., 2014). Although developing mathematical competence is often seen as the primary goal of instruction, several scholars argue that maintaining students' motivation towards mathematics is equally, if not more, important in the long term (Gilbert, 2016; Gutsstein, 2007; Niemi et al., 2025). When motivation is supported, students are better prepared for lifelong learning and more likely to continue developing their skills beyond formal education. Therefore, alongside competence development, fostering motivation should be a central focus, not merely its short-term link to achievement.

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Motivation has been studied for decades (e.g., Deci & Ryan, 2000; Eccles & Wigfield, 2020), and various motivation theories have been developed to explain motivational processes and factors. Koenka (2020) has identified five prominent theories of academic motivation – achievement goal theory (AGT), attribution theory (AT), expectancy-value theory (EVT), self-determination theory (SDT), and social-cognitive theory (SCT), while Urhahne and Wijnia (2023) add interest theory (IT) to this list.

Researchers frequently develop their own terminology and expand existing theories (Urhahne & Wijnia, 2023), which blurs the boundaries between different models and prompts the question of whether a unified theoretical framework could better explain the main theories of academic motivation along with their similarities and differences. In this context, research on student motivation has primarily concentrated on students across various levels of schooling (e.g., Jansen et al., 2022), often neglecting younger students. Some tools designed to assess older students are also applied to younger grades without recognising that they may not be suitable for this age group in their original form (e.g., Pintrich, 1999).

This article examines the learning motivation in mathematics among students aged 6–13 by reviewing research articles published between 2010 and 2022. To better support the ongoing development of motivation in students aged 6–13, more understanding is needed about its nature and the factors that influence it. This systematic literature review aims to provide an overview of the most commonly used motivation theories and the instruments employed to investigate learning motivation in mathematics among 6–13-year-olds. To accomplish this, two research questions are posed:

1. How has learning motivation in the context of mathematics been conceptualised in previous empirical studies involving students aged 6–13?
2. What instruments have been employed to examine learning motivation in the context of mathematics among students aged 6–13?

## Methodology

A principal search, followed by two further inquiries, was conducted in October 2020 using the EBSCO Discovery interface across various databases to gather the survey sample. The search terms were categorised into three main groups for the study: motivation, mathematics, and educational attainment. The search was limited to items that were available in full text, published since 2010 in English, and peer-reviewed. This search yielded 766 results. Following PRISMA guidelines (Page et al., 2021), articles were included if they focused on students in grades 1–6, motivation, and mathematics. Exclusion criteria removed

articles that broadly addressed STEM, lacked explicit motivation theories, or did not include suitable instruments. Two researchers, along with the first author, reviewed the abstracts of the 766 sources identified during the initial search to ensure the study's reliability. In the second stage, articles were assessed based on the full text, and in the final stage, those remaining for further review were read by all authors.

An additional search was carried out using the same criteria in August 2022, adding seven articles for further analysis. A third search was conducted on 31 December 2022, adding 12 more articles. Combining the main search with these two additional queries identified 974 articles for analysis. After applying the exclusion and inclusion criteria, 56 progressed for further study.

### Key findings and discussion

Analyses revealed that the 56 articles were published across 34 journals, primarily focusing on European students, followed by those in North America and Asia. The articles encompassed various study designs, such as cross-sectional, longitudinal, and experimental studies, and covered an age range of 6 to 13 years. Further analyses indicated that out of the 56 articles, 17 were based solely on EVT, ten on SDT, and six on AGT. AT was represented in three articles, SCT in two, and IT in one article. The remaining 23 articles either combined two or more motivation theories or did not specify the theory used, although the framework could be inferred from the concepts employed. Out of the 56 articles, 24 predominantly utilised EVT as the theoretical framework, while 16 employed AGT. Overall, 76% of the articles used EVT, SDT, or AGT as one of their foundational theories. Only one article (i.e., Linder et al., 2015) incorporated elements from five theoretical frameworks – IT, AT, EVT, and AGT – in their 17-item instrument, examining the motivation of 2nd–5th grade students in the USA.

The analysis showed that the dimension of interest was the main focus in most studies examining students' motivation for learning mathematics. Given the complexity of motivation (Schunk et al., 2014), an unwarranted focus on individual dimensions alone can neglect the broader importance of motivation and underestimate its complex nature. Although EVT by Eccles and colleagues (Eccles et al., 1983; Eccles & Wigfield, 2020) was the most commonly used motivation theory, its key construct dimensions – intrinsic value, attainment value, cost, utility value – were unevenly represented in the instruments used. This biased representation may be due to the difficulty of examining multiple dimensions at once, especially since some, like cost, are harder to explore – particularly among younger students. The motivation of students aged 6–13 is influenced by external factors such as teachers, parents, friends,

and hobbies. However, overlooking the impact of these situational components, which are crucial for understanding motivation (Eccles & Wigfield, 2020), may lead to misinterpretation if we focus solely on the interest dimension. Furthermore, limiting the focus does not assist future research or practitioners when designing interventions to understand the diversity in their classrooms or how to support students' development and sustained engagement.

The systematic literature review identified PALS (Midgley et al., 2000) as the most frequently used instrument for studying students' motivation to learn mathematics, mainly applied from the age of 9. Although it is often used alone, PALS is frequently combined with other instruments. Within the framework of SDT, ESMS (Guay et al., 2010) has been a widely adopted and validated instrument across various languages, enabling comparisons between regions and countries.

The findings of the present study, which focused on a quantitative research approach, provide valuable insights into the study of learning motivation in mathematics among 6–13-year-old students. They offer an understanding of the most commonly used instruments within the framework of significant theories established in motivation research. This article systematically describes motivation, facilitating the development of additional instruments and the assessment and monitoring of motivation. Future studies should consider adopting multi-model and longitudinal approaches to better capture situational influences and promote sustained interest in mathematics learning.

*Keywords:* motivation, mathematics, systematic literature review, 6–13-year-old students