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Mini Review

Understanding Math Motivation: Domain-Specific Patterns in Students' Motivational Beliefs

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Abstract

This paper explores the domain specificity of students' motivation for learning mathematics, drawing on multiple theoretical frameworks, including expectancy-value theory, self-efficacy theory, and achievement goal theory. While motivational constructs such as competence beliefs and task values consistently show strong domain-specific patterns, particularly in math, evidence for domain specificity in intelligence beliefs and achievement goal orientation remains mixed. The findings underscore the importance of studying motivation within specific subject contexts, particularly mathematics, to support adaptive learning and development.

Supporting students' academic motivation and a long-term positive attitude to learn math is a major area of interest within the fields of Educational Psychology and Math Education. Math motivation plays a critical role in students' math learning and is associated with students' academic outcomes, engagement and persistence, and future academic and career choices [1,2]. There has been a long history of discussion about the generality and uniqueness of students' motivation. This paper focuses on the question of whether and how students' motivation to learn mathematics is different from their motivation to learn other subjects and their general motivation for learning.

Multiple theoretical perspectives proposed different motivational constructs to explain students' learning and motivational processes, such as self-efficacy theory [3], expectancy-value theory [4], achievement goal theory [5], and self-determination theory [6]. The ways that different theoretical perspectives conceptualized their key motivational constructs implied their basic assumptions of the association between students' motivation and subject domains.

Self-perception of Competence

Young children can differentiate their competence beliefs for different subject domains as early as first grade [7]. When discussing school experiences, children frequently refer to their performance within a given subject. If students perceive they are competent in one subject domain, they are likely to engage in relevant learning tasks, exert efforts, and choose relevant courses, majors, and careers [8]. Researchers argued that when exploring students' competence beliefs, it is important to recognize the differences among students' competence beliefs across subject domains in order to further explain students' performance and behaviour [9]. Domain specificity of students' competence beliefs was generally addressed by two clusters of empirical evidence: (1) studies using factor analytic approach showed that students' competence beliefs in multiple academic domains formed different factors [10], and (2) students' competence beliefs measured within a specific domain better predict their performance in corresponding tasks and domain, comparing to the general academic competence beliefs or competence beliefs in other subjects [9].

Subjective Task Value and Intrinsic Motivation

Multiple theoretical perspectives addressed the question of why students engage in learning activities. Expectancy-value theory [11] emphasized the importance of four components of subjective task values: attainment value, intrinsic value, utility value, and cost. The degree of importance, usefulness, and enjoyment students perceive towards certain subject domains is associated with their future academic and career choices in corresponding areas. Eccles et al. [11] measured elementary school children's subjective value beliefs across subject domains (i.e., math, reading, sports, and instrumental music), and examined the factorial structure of task value. Results from factor analysis showed that children's value beliefs for different subject areas formed distinct factors, indicating that even young children could distinguish their value beliefs for various subject domains. Students who are interested in math or find being good at math important might not feel the same way about reading or science. Bong's study [10,12] also supported the domain specificity of students' task value and revealed that students' subjective value beliefs across domains become more distinct from middle school to high school years. The weak association of value beliefs across domains was also found in studies focused on high school and college student samples [13,14]. One of the important reasons for high school students' task value becoming more distinct than those of younger students is that high school students are facing significant decisions regarding their college major and future career plan. Therefore, high school students tend to attach different degrees of importance and usefulness to various subject domains depending on their academic and occupational aspirations.

Intelligence Beliefs and Achievement Goal Orientation

Compared with the extensive body of research focused on the domain-specificity of students' competence and value beliefs, relatively little is known about the differences in students' mindset and achievement goal orientation across domains. Dweck [15] identified two types of mindsets regarding how children understand the nature of ability or intelligence. Children who hold a fixed mindset believe that ability is unchanging and tend to endorse the performance goal that focuses on the demonstration of their ability. Conversely, children who have a growth mindset believe that ability is malleable and can be changed through learning and development. Those children tend to endorse the mastery goal orientation, which focuses on the development of ability. Students' mindset and achievement goal orientation have significant effects on their school functioning and long-term success [16].

Some researchers argued that students' views of the nature of intelligence and achievement goal orientation are conceptualized as domain-general motivation constructs, which reflect a relatively stable individual disposition [13]. However, other researchers argued that students might have different understandings of the ability for various domains [15,17]. For example, students may consider math ability as fixed and unchanging, whereas they believe they can improve their reading or writing ability through effort. However, the studies focused on the domain specificity of mindset and achievement goal orientation received inconsistent results. Some studies have supported the domain-general model of achievement goals and mindsets, showing strong overlap across different academic and non-academic areas for students of various ages [13,18,19]. However, some other research suggests a conceptual distinction, with mastery goals demonstrating domain specificity while performance goals appear more domain-general [10,12].

Conclusion

Students' learning and motivational processes contain both domain-general and domain-specific aspects. As suggested by Patrick et al. [20], it is adaptive for students to "develop and extend their motivation for particular subjects, and ideally for learning in general." However, for researchers, it is important to measure and explain the relevant construct within the subject domain when examining the relationship between students' motivational beliefs and academic performance and behaviour patterns in certain domains.

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Conflict of Interest

No conflict of interest.

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