

An Investigation of Motivational Constructs in Mathematics for Students Across Elementary Grades

Executive Summary

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Purpose

The purpose of this study is to investigate students' motivational constructs in mathematics across grades one through five in schools that are currently implementing an inquiry-based mathematics curriculum. Results of this study can provide data about motivational patterns in elementary mathematics in early to late grades and may have implications for curriculum implementation and instructional strategies of teachers.

Theoretical Framework

Motivation is a psychological characteristic integral for students to be successful (Schunk, 1991). Studies have shown that highly motivated students are more likely to engage in behaviors that enhance academic performance (DiPerna, Volpe, & Elliott, 2005; Whang & Hancock, 1994), including effective goal-setting, focusing effort, and persisting in academic challenges (Ormrod, 2006). Highly motivated students also are more likely to view academic tasks as valuable and important (Pintrich & Schunk, 2002). Motivation has also been connected to a students' level of cognitive engagement and use of metacognitive strategies (Pintrich & DeGroot, 1990a). Students who exhibit high motivation for a task are more likely to utilize effective cognitive strategies for encoding new information (Ryan, Ryan, Arbuthnot, & Samuels, 2007). These students display a tendency to employ critical thinking skills in problem-solving situations and integrate prior knowledge with new information. Motivated students, in other words, are better equipped to learn than unmotivated students.

Motivation research typically has focused on the academic drive and related learning outcomes of older students. Thus, the needs of early elementary school teachers who wish to measure and then attempt to enhance their students' motivation have not been fully addressed. This is unfortunate, because early elementary years (i.e., Kindergarten through third grade) are critical to a child's development of attitudes about schooling, as well as a child's academic motivation (Perry & Weinstein, 1998). Such formative years can often set a precedent for either academic success or failure in later grades. The current study aims to address the topic of math motivational constructs in elementary children and examine possible interactions between grade levels.

Method

Participants

Participants were 1,018 students from a suburban school district in the northwest area of South Carolina. Students ranged from grade one to grade five, with the following numbers represented from each grade level: Grade one (137 students), grade two (209 students), grade three (241 students), grade four (200 students), grade five (231 students). Students were recruited from five school sites, all of which were participating three year grant from the Commission of Higher Education in South Carolina dedicated to improving teacher quality through the implementation of an inquiry-based mathematics curriculum and professional development program. This program is described briefly in the section below. The only criterion for student participation was parental consent.

Program Implementation

The grant in which teachers were participating at these five schools called for the implementation of a K-5 mathematics curriculum developed at Clemson University through the College of Engineering and Science in an effort to increase student achievement and improve teacher quality in mathematics. This curriculum, called Math Out of the Box™, is designed with four interrelated strands: Developing Algebraic Thinking, Developing Measurement Benchmarks, Developing Geometric Logic, and Developing Number Concepts. Teachers at these schools taught three out of the four strands in the 2007-2008 school year. The fourth and final strand, Developing Number Concepts will be implemented in the upcoming school year. Teachers were trained on the Math Out of the Box materials through an inquiry-based professional development model where they were immersed in tasks in which the facilitator supported an inquiry-based learning environment.

Instrumentation

A 17-item survey was designed to measure cognitive and social cognitive motivational constructs related to math for elementary students. Differing items contained statements of disposition toward math, prompting students to respond with a four-point Likert-type scale (4 = *Just like me*, 3 = *Sort of like me*, 2 = *Not really like me*, and 1 = *Definitely not like me*). Items in the instrument were written to prompt a judgment related to (1) anxiety (Shipman & Shipman, 1985), (2) interest (Hidi & Anderson, 1992), (3) task value (Wigfield & Eccles, 2002), (4) self-efficacy (Bandura, 1986), and (5) goal orientation (Elliott & McGregor, 2000).

Procedure

A total of 117 classrooms participated in this study and each student's involvement was contingent on informed consent. All surveys were administered by the teacher or a school math coach in the students' regular classroom setting. All surveys were completed during the same two-week time period during the last month of the school year.

Results

Reliability

Reliability for the math motivation scale was estimated by computing the Cronbach's Alpha (0.833). This coefficient demonstrated high reliability for the scale.

Factor Analysis

The dimensionality of the 17 items from the motivation scale was analyzed using principle components factor analysis. Three factors emerged from this analysis: Factor 1 was labeled *Math Anxiety*; Factor 2 was labeled *Math Self-Efficacy*; and Factor 3 was labeled *Value of Math*.

Analysis of Variance

A one-way analysis of variance was conducted to evaluate the relationship between grade level and each of the following factors: (1) math anxiety (2) math self-efficacy and (3) value of math. The independent variable, grade level, included five levels, represented by grades one through five. The dependent variable was the student score for each factor on the motivational scale, identified through factor analysis. Findings are as follows:

- Students in grade one reported significantly lower math anxiety than grades three, four, and five. Grade two also reported significantly lower math anxiety than grades four and five.
- Student in grade one reported higher math self-efficacy than students in grades three, four, and five. There were no additional significant differences between self-efficacy and grade level.
- Students in grade five reported significantly lower value for math than students in grades two and three.

Discussion

Results from this study indicate that students in the lower grades at these five schools report less math anxiety and higher self-efficacy in mathematics. These results raise questions about possible reasons for this discrepancy, including the need to investigate issues of increased math anxiety as a result of testing pressure or rising levels of difficulty in content. These results also raise questions about factors at the schools that may account for the reduced levels of motivation at the higher grades such as classroom environment, teacher quality, or fidelity of implementation. Fifth grade students at these schools report a significantly lower value of mathematics than students in other grades. Value is essential for students to be motivated in mathematics (DiPerna, Volpe, & Elliott, 2005). It is necessary to explore how the role of the teacher and the curriculum account for such a change in attitudes. It would also be beneficial to compare the motivation of upper elementary students whose teachers are using an inquiry-based curriculum to students whose teachers are using a more traditional mathematics curriculum where procedural knowledge is emphasized over the development of conceptual understanding. While students at the upper elementary grades report less motivation for mathematics than students in lower grades, it is unclear if they have more motivation than students in other schools where a traditional mathematics curriculum is implemented.

This research also provides information for stakeholders at these schools acting in a supportive role as teachers implement this new mathematics curriculum. These stakeholders include the math coaches at each of the schools who provide daily support to teachers in addition to facilitators from Clemson University who will provide weekly support through content-focused professional-development for grade-level teams of teachers. The need to increase student motivation at the upper elementary levels in these schools will become a primary goal of these professional development sessions in the upcoming school year.

References

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** For a more detailed analysis of this study, please contact the authors. Do not cite this publication.