Changing Embedded Student Attitudes within a Mathematical Setting

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Abstract

Existing student attitudes and beliefs about mathematics often block student learning and deep understanding of mathematical content in the college classroom (e.g. preservice elementary teachers).

Changes in pedagogy, classroom participation, and curriculum were infused into two college mathematics classes for preservice teachers and the attitudinal beliefs of these preservice teachers were assessed to measure change after a course intervention.

Problem

Preservice elementary teachers nationally present attitudes in mathematics about content and their own beliefs in their ability to teach mathematics in the elementary school setting. These attitudes, issues of math anxiety, and in many cases lack of confidence, are interfering with these teachers ability to teach mathematics effectively.

Purpose

The purpose of the research was to study preservice teacher attitudes towards mathematics before and after taking two modified college credit courses in mathematical content and methods.
Changes made in the course were focused on three areas:

- An emphasis on student experiential learning in the curriculum,
- improving the quality and quantity of preservice teacher communications to the course teacher, to their classmates, and to others outside the courses,
- and the pedagogy chosen by the classroom teacher.

Students apply their understanding of statistics in this example of a human box plot which uses students as data points (Collins, 2005).

Relevant Literature

Math anxiety (MA) in elementary students in a well-documented topic of study, and this type of anxiety is recognized as an impediment to math achievement for elementary students. (Beilock, Gunderson, Ramirez, and Levine (2009). But math anxiety and subsequent lack of math confidence in elementary classroom teachers has not generated a similar amount of research.

Classroom activities, assessments, and lectures performed in isolation, even when aimed at the learning of content, do not allay the MA for students in math classes (Vinson, McCulloch, Haynes, Brasher, Sloan, and Gresham, 1997).

Furthermore, math anxiety in female elementary teachers affects the success rates of female students in their classes in a measurable and negative way. Eighty-seven percent of elementary teachers in the U.S. are female (Beilock et al, 2009).

Research Questions

Can long-held student beliefs about their current knowledge in mathematics and their attitudes toward learning of new mathematics be changed through course modifications In experiential learning and pedagogical methods modification?

Can the use of specific pedagogical methods (preservice teacher Math Talk and verbal and written explanations of problem solving using drawings and manipulatives) in two college mathematics classes contribute to a positive and measurable change in student attitudes and confidence in mathematical thinking?

Procedures

This was a population study of all preservice teachers taking the content and method coursework in mathematics at a two-year college in Delaware from 2003-2004, fall and spring classes (n = 156 students).
The collection instrument (Student Attitudinal Survey, 2003) was used in a matched blind study of all enrolled students in preservice teacher mathematics classrooms over a two year period and the survey was administered and analyzed by an outside evaluator.

The survey was designed to measure student changes in attitude toward in 4 major categories: confidence in understanding math, confidence in teaching math, liking the content in math studied, and confidence in explaining student thinking to others.

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Data Analysis

Data collected were analyzed and compared by using a survey collection model (SAS) on topics of perceived content acquisition and attitudinal changes toward mathematics.

The Student Attitude Survey (SAS) explores students' deeply held beliefs about mathematics and learning of mathematics, as well as their propensity for sharing private thinking. The survey consists of 30 items, and respondents reported the extent to which they agreed or disagreed with each item on a on a Likert scale.
A factor analysis was performed which assigned items to subscale groups before analysis by topic for reliability. Order of items was changed in the second survey collection and some items were reversed for reliability

Findings

The courses, led, designed, and written by Collins, proved to be the highest scoring courses in terms of positive measured student attitudinal changes towards mathematics and the teaching of mathematics from the group of seventeen colleges in the study. Measured change for all items was statistically significant in the Collins study. Collins has since used these pedagogical shifts at Walden to improve candidate positive attitudes toward math in coursework.

Limitations

Collins' study was of attitudes towards mathematics of 156 preservice elementary majors at a two-year college in Delaware.
Research study at the other sixteen institutions tied quantitative literacy to individual content in other disciplines, but not necessarily math education, limiting the generalizability of the study.
Generalizability to other levels of mathematics and to the preservice population nationally was not explored nor was the methodology for this particular research replicated.

Conclusions (ongoing)

Collins has continued to use the results of this research for the last ten years within the national two-year college system and has continued the modifications made to these courses for preservice teachers in mathematics through conference presentations and other college mentoring.

- **This study provided some evidence that preservice teachers attitudes towards the teaching and learning of mathematics improve with the inclusion of specific course modifications and the correct choices of pedagogical approaches.**
- Subsequent to this research additional publications from NCTM, MAA, AMATYC, and NACCTEP have supported the use of these same methods in terms of effecting change in mathematical retention and teacher attitudes towards mathematics.

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Social Change Implications

National emphasis has focused on the improvement of content standards in mathematics and on teachers and their pedagogical approaches to mathematics (CCSS, 2009**). Improving preservice teacher at the undergraduate learning and attitudes towards mathematics will eventually allow those teachers to strengthen their thinking, logical reasoning, and their ability to be effective in classrooms in the U.S.** Teacher attitude toward the content is a large piece of the classroom environment and student understanding of that content.

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