

Changing Students' Perception of Mathematics through An Integrated, Collaborative, Field-Based Approach To Teaching and Learning Mathematics

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This paper provided the preliminary results of a study documenting changes on pre-service teachers' attitude and perception of mathematics after the implementation of an Integrated, Collaborative, Field-Based Approach to Teaching and Learning mathematics. All the blocks (consisted of mathematics content, mathematics methodology and pedagogy courses) taken by pre-service teachers in spring 2002 at a four-year southwest university participated in the study. The findings reported here are from one of the blocks where the integrated approach was fully implemented. The preliminary results indicate that students had noticeable positive changes on their attitude towards and perception of mathematics. Many of them became more optimistic about their ability to do mathematics. Educators of prospective teachers can consider approaches similar to the one reported here in order to address low motivation and negative attitude toward mathematics.

Introduction

Low self-esteem and math phobia in mathematics learning seem to result in confused thinking, disorganization, avoidance behavior, and passivity (Conte, 1991; Zentall&Zentall, 1983). Students' attitude towards math seems to be shaped by how students define mathematics, and what they consider the role of mathematics is in their life. For instance, a student considering mathematics as bunch of symbols and procedures tends to treat his/her mathematics concepts as a set of memorization facts. This student will not put any effort to understand "whys." If a student does not think mathematics is important then the student will not again consider his/her math course worthy enough to spend time on. Motivation of these students would be very low. Then it will be difficult to have students learn mathematics meaningfully and have understanding. This means one needs to address students' attitudes and behaviors before introducing mathematical concepts and expecting meaningful learning in his class.

Preliminary findings from a pre-survey administered, during 2001-2002 semesters, at a four-year southwest university in mathematics content courses offered for pre-service teachers indicate that the majority of preservice teachers, most of whom are Hispanic and female, come into mathematics courses with negative attitude towards and the fear of the subject. These students definition of mathematics reflect more of a subject that is all about symbols, notations, equations, formulas and procedures that are to be memorized. To the students, mathematics is not necessary for them to be effective teachers. The majority on the pre-survey states that their expectation from the class is to learn how to teach math. They do not see improving their skills and mathematical content knowledge as important as learning methodology of mathematics. Their belief, attitude

and fear toward math shows up as low confidence in their ability to do mathematics, passivity and less or no effort towards mathematics activities. Even though, majority has potential to learn and understand mathematics, high math anxiety seems to be affecting their cognitive abilities. The response of a preservice teacher to “What is mathematics” on a pre-survey is a testimony to the gravity of the problem:

“math is a fear I have not been able to conquer; the fear of math has put a block on my brain; I don't like math because I feel very dumb when after so many years I still don't comprehend it.”

Negativity towards mathematics also seems to determine pre-service teachers’ areas of specialization. About 90 percent of our preservice teachers choose to specialize in areas other than mathematics. Then, one would agree that one needs to address behavioral issues before expecting learning, full participation and understanding of mathematics from pre-service teachers.

A pedagogical approach, An Integrated, Collaborative, Field-Based Approach to Teaching and Learning Mathematics (see figure 1), has emerged as a result of discussions between mathematics and education faculty. The goal of the approach is to enhance preservice teachers’ mathematical knowledge by making positive changes on their attitude towards and perception of mathematics. It is expected that high confidence in their ability to do mathematics will result in a positive attitude and thus an increase in motivation. This will also result in advancement of students’ mathematical knowledge. In the long term, preservice teachers with enhanced content knowledge and higher confidence will graduate students with positive attitude toward and perception of mathematics.

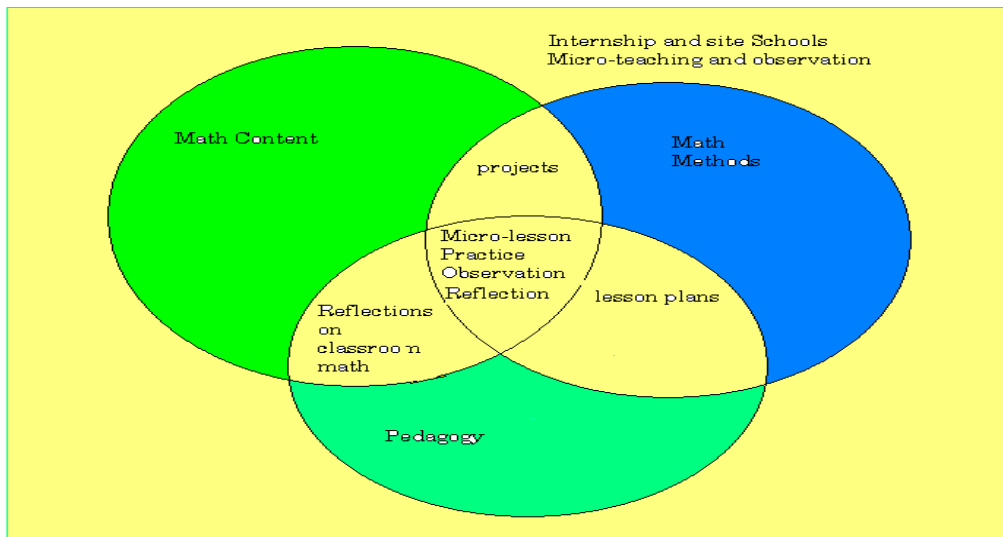


Figure 1. Diagram of an integrated, collaborative, field-based approach to teaching mathematics.

The pedagogical approach is integrated into the existing field based block courses. Block courses are consisted of three subjects. Pre-service teachers are asked to take the courses in a cohort setting within the same block. Two of these courses are education courses; pedagogy of teaching and learning and methodology of mathematics education at elementary and middle school levels. The third one is the mathematics content course. Normally, the block courses are taught in isolation. There is little to no collaboration between the faculty even though students in each block are asked to take the three courses together in their designated blocks.

The pedagogical cycle of Learn, Practice and Teach, integration and collaboration between faculty, university and local area schools are the core ideas of the approach. The following summarizes the activities the approach implemented in the blocks:

- Full collaboration of the three faculty members (mathematics and education faculty); the faculty teach the three courses together in collaboration.
- Full collaboration of local area schools and the university.
- Mathematics is the common theme for the three courses.
- Students are first asked to advance their content knowledge through inquiry-based activities, mostly through mathematics projects, with the guidance of the three faculty, and support of their classmates. Students are asked to discover and further their understanding of mathematical concepts while working on projects in groups of at most 5, providing support for group members through out the learning process.
- With the guidance of the three block faculty members, primarily the methodology instructor, preservice teachers are asked to develop mini-lessons on the math content learned.
- Before teaching mini-lessons in an elementary classroom, students are asked to practice the micro-lessons. During rehearsal, they get feedback from the three instructors and their classmates.
- During microteaching, the block instructors and the in-service teachers mentoring preservice teachers make observations. The microteachings are taken place during the time allocated for pedagogy and mathematics content courses.
- After the microteaching, during the time reserved for the pedagogy course, students and the faculty meet back and discuss students' performance during the microteaching. Discussion is mostly about content and pedagogical issues that occurred. The faculty provide constructive feedback and suggestions for future microteachings.
- In service mentor teachers provide constructive feedback and suggestions for future microteachings.

Results and Discussion

Inquiry based group work and teaching of micro-lessons seem to make preservice teachers become more aware of the importance of mathematics in order to be effective teachers, and to appropriately and accurately respond to variety of questions their future students may pose, which in turn motivates students to participate more in math content

activities, and as a result increases confidence in their ability to do mathematics. Figure 2 outlines some of the changes, due to the integrated approach, that occurred on a group (they are all from one of the blocks with full implementation of the integrated approach) of pre-service teachers' perception of mathematics. Students seemed to become more optimistic about their ability to do mathematics. At the end of the semester, more students indicated that

- Mathematics is a way to solve problems.
- Mathematics is helpful to understand real life problems/issues.
- Mathematics involves critical and logical thinking and reasoning.

Fewer students indicated that:

- Mathematics is all about formulas.
- Mathematics is difficult.

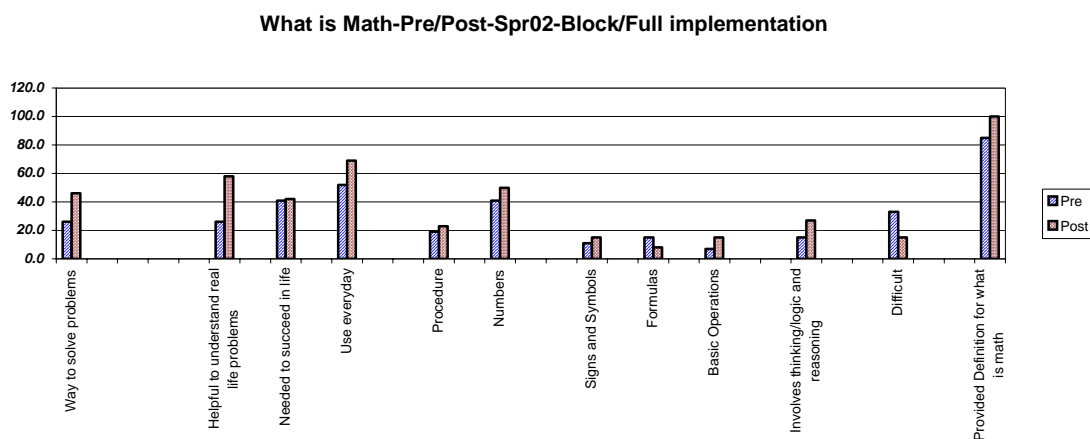


Figure 2. Percentage of Pre-service Teachers' response to "What is Math" on pre- and post- surveys.

A curious result observed is that a higher percentage of students provided a definition for mathematics than those providing a definition at the beginning of the semester. It will be worth further considering possible implications of this result.

Conclusion

This paper provided a short outline of preliminary results of a study documenting changes, due to the integrated approach, on preservice teachers' attitude and perception of mathematics. One should be cautious however when interpreting the results discussed on this paper. There is still work to be done before finalizing and generalizing the observed patterns. Overall, one would agree that what is reported here seems to imply possible positive effects of the integrated approach on preservice teachers' perception of mathematics, and their attitude towards mathematics. Approaches similar to the one reported here may be used to address low motivation and negative attitude toward mathematics. I would like to end the paper by a preservice teacher's end of semester response to "what is mathematics" on a post-survey:

“Mathematics is a way of coming up with your own solutions to any problem given... It is a chance to explore and play with numbers ...It is feeling free to be different and think differently...over all it is being able to discover new and interesting things that make problem solving not only easier but a lot more fun.”

References

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