A Mathematics Course for Pre-Service Elementary Teachers using Inquiry Based Learning and Technology

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Abstract

A course titled Concepts and Structures in Mathematics II has been developed (partially funded by NASA Opportunities for Visionary Academics grant) and taught at Jackson State University during Fall 2005 and Spring 2006. This course is designed for pre-service elementary teachers in alignment with NCTM standards, Mississippi curriculum framework, expectations from ETS in PRAXIS I.

1 Introduction

According to the National Assessment of Educational Progress (NAEP), Mississippi received the lowest average score in mathematics for grade 4 students among all the states in 2000. In 2003, 39% of grade 4 students were at or below the basic level. According to No Child

\footnote{This project is partially supported by NASA Opportunities for Visionary Academics award.}
Left Behind (NCLB) statewide accountability system, six (6) elementary schools in the
Jackson Public School system are low or under performing. A new course, Concepts and
Structures of Mathematics II (with course number Math-227), is designed to prepare future
elementary teachers with the necessary education and instructional strategies to improve
this situation in elementary schools. This is a report of the results of the research study of
pre-service teachers’ change in learning mathematics and attitudes towards mathematics.

2 Course Description

The content for this course includes statistical graphs, measures of central tendencies,
variation, odds and probabilities, conditional probabilities, expected value, and uses and
abuses of statistics. The course also includes an introduction to geometry and concepts of
measurement. Inquiry based learning and use of technology (such as graphing calculators)
are integrated into the course. NASA educational materials, such as NASA space mathematics,
NASA CORE, GLOBE data collection, etcetera, are incorporated in the course. NASA
materials help students appreciate the applicability and beauty of mathematics, and the
students, in turn, pass this appreciation to their future students. This course promotes
logical reasoning to help foster life–long learning, an essential quality for teachers of
mathematics.

More information about this course is available at the website

http://ccaix.jsums.edu/~vijaya.gompa/nova/math227.htm

This website provides information regarding textbooks, course objectives, course content,
assignment schedule, grading scale, assessment rubric, and student activities.

3 Highlights of Instructional Strategies

3.1 Cooperative Learning

Slavin and Oickle (1981) stated that using cooperative learning groups was a more effective
teaching strategy for students of color than for white students in terms of achievement.
More researchers, (Cohen (1986), Slavin (1990)) found that students of color showed
greater academic gains in cooperative learning settings than in traditional classrooms. The
cooperative learning strategies improved student performance in mathematics (Devries and Slavin (1978), Okebukola (1985), Slavin (1985), Treisman (1992)).

Since the majority of our students are African American, we incorporated cooperative learning strategies in this course and found improved student achievement. Students were asked to work in groups to carry out several activities that enrich the understanding of the concepts. In addition to individual projects, students were required to actively participate in group projects. Periodical reviews were done in group settings. As some students were not comfortable with the use of technology, they were made part of groups with students possessing strong backgrounds in technology. As a result, all students were able to learn from each other and to do well in the course.

3.2 Inquiry Based Learning

We adopted inquiry based learning strategies (Ausubel (1968), Barell (1998), Joyce, Calhoun, and Weil (2000)). Some concepts were introduced after appropriate experiments by students. For example, students were asked to conduct an experiment and compute empirical probabilities before theoretical probabilities were discussed in the class.

3.3 Learner Centered Instruction

Based on a survey of student interests and needs at the beginning of the semester, the course was tailored for the students. Constant feedback was sought from the students to improve their learning experience. As a result, students were excited about what they were learning. Students exhibited increased confidence levels in approaching the solving of a problem as they progressed to learn increasingly more challenging concepts. Students were always punctual, and none dropped out from the course.

4 Project Evaluation

Many aspects of the course were observed during Fall 2005 and Spring 2006. Several surveys were administered at the beginning and end of each semester. One of the survey instruments was developed by our co-principal investigator, Benjamin C. Ngwudike, and was later modified by us and used in Spring 2006 to track changes in attitudes more efficiently.
While this course was intended for sophomore students, a disproportionate number of students who took the course were seniors. Out of 22 students who took the course in the Fall of 2005, 72.5% (16 of 22) were seniors, 22.7% (5 of 22) were juniors, and only 4.6% (1 of 22) were sophomores. The faculty of the Departments of Mathematics and Elementary and Early Childhood Education will devise a system to ensure that teacher education students take this course in their sophomore year. Doing this will enable the students to deepen their content knowledge needed for passing the mathematics section of PRAXIS I and II tests.

The following two action research questions guided our project evaluation process:

1. Do pre-service Teacher Education students, who take Math–227 that integrates NASA materials, achieve higher than students who do not?

   The initial data available from course grades indicated that students who took this course section outperformed students in comparable classes. When all of the students complete their series PRAXIS tests, the data will be analyzed to further answer this question.

2. Do pre-service Teacher Education students, who take Math–227 that integrates NASA materials, develop better attitude toward mathematics than the students who do not?

   This project integrated materials and technology in the teaching and learning of this course. The project attempted to relate the teaching and learning of mathematics to everyday life.

   Exit surveys of students who took this course in Fall 2005 were used to answer research question two. About 23.8% of the students (5 of 21) strongly agreed that relating the teaching and learning of mathematics to everyday life was critical to doing well in the subject; 57.1% agreed (12 of 21). On integrating technology in teaching and learning of this course; 33.3% (7 of 21) strongly agreed that it was a good way to learn mathematics, and 52.4% (11 of 21) agreed. Further, students indicated that receiving extra help from professors helped them to do well in mathematics and change their attitudes toward the subject.

   Our survey and observations indicated positive changes in almost all of our measures of learning mathematics and attitudes toward mathematics. A sample of students responses...
during Spring 2006\(^1\) is depicted in the table below.

<table>
<thead>
<tr>
<th>Mathematics is easy for me to learn</th>
<th>Pre-Course</th>
<th>Post-Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>3</td>
<td>15.8</td>
</tr>
<tr>
<td>Agree</td>
<td>8</td>
<td>42.1</td>
</tr>
<tr>
<td>Disagree</td>
<td>7</td>
<td>36.8</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>1</td>
<td>5.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I am good in solving mathematics problems</th>
<th>Pre-Course</th>
<th>Post-Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>4</td>
<td>21.1</td>
</tr>
<tr>
<td>Agree</td>
<td>9</td>
<td>47.4</td>
</tr>
<tr>
<td>Disagree</td>
<td>3</td>
<td>15.8</td>
</tr>
<tr>
<td>Strongly disagree</td>
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<td>5.2</td>
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<td>10.5</td>
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</table>

<table>
<thead>
<tr>
<th>No matter how hard I try, I am not good in solving mathematics problems</th>
<th>Pre-Course</th>
<th>Post-Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
</tr>
<tr>
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<td>5.3</td>
</tr>
<tr>
<td>Agree</td>
<td>5</td>
<td>26.3</td>
</tr>
<tr>
<td>Disagree</td>
<td>6</td>
<td>31.6</td>
</tr>
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<td>26.3</td>
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<td>Missing</td>
<td>2</td>
<td>10.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I will do better in mathematics if it can be related to everyday life</th>
<th>Pre-Course</th>
<th>Post-Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>frequency</td>
<td>percentage</td>
</tr>
<tr>
<td>Strongly agree</td>
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<td>42.1</td>
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<tr>
<td>Agree</td>
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<tr>
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</table>

\(^1\)The authors are indebted to Dr. Benjamin C. Ngwudike for his contribution of developing the survey instrument and running the statistical analysis.
References


