THE DEVELOPMENT OF JUNIOR INTERMEDIATE PRESERVICE TEACHERS’ MATHEMATICAL KNOWLEDGE AND VALUES

By

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This study focused on measuring preservice teachers’ conceptual and procedural mathematical knowledge and values before and after a mathematics methods course.
Mathematics Methods Course
Reform Based Approach

Included
- Numeracy, Geometry and Patterning

NCTM 2000
- Principles and Standards – Teaching strategies

Instruction Focused on
- Construction of ideas
- Building knowledge
- Manipulatives, computer software and calculators
- Sharing knowledge and ideas
- Open-ended problems
- Coach or facilitator
- Class assessment
Goals of the Study

- Knowledge and values
- Academic background
- Regression model
Design

One-Group Pretest-Posttest

Advantage
Pretest data can be used as a reference to compare post-test data

Disadvantage
No control group
Threats to the internal validity of the data
Participants

N=111

Preservice Teachers (gr 4-10)

N=111

• 82 nonmathematics
• 29 mathematics

EDUC 4151

• Sept 2005
• Feb 2006
Instrument and Measurements
- Perceptions of Mathematics Questionnaire (POM)
- Demographics Variables
- Conceptual and Procedural Knowledge and Values

Procedure and Analysis
- Descriptive Statistics Pretest and Post-test
- T-test Repeated Measures
- Factorial Anovas
- Effect Sizes
- Correlations
- Regression Model
Change in Procedural Mathematical Knowledge

PK

Pre-test
Post-test
Change in Conceptual and Procedural Mathematical Knowledge

CK

PK
Procedural Knowledge Pre and Post-test Based on Preservice Teachers’ Background

<table>
<thead>
<tr>
<th>Background</th>
<th>Time</th>
<th>Means Procedural Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-math</td>
<td>pre-test</td>
<td>6.5</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>math</td>
<td>post-test</td>
<td>9.0</td>
</tr>
</tbody>
</table>

The graph shows the improvement in procedural knowledge over time (pre-test to post-test) for preservice teachers with different backgrounds (non-math and math). The graph indicates a steady increase in procedural knowledge for both groups, with a higher mean for the math group post-test compared to the non-math group.
Conceptual Knowledge Pre and Post-test Based on Preservice Teachers’ Background
Change in Procedural Mathematical Values

PV

Pre-test
Post-test
Change in Conceptual and Procedural Mathematical Values

![Bar graph showing changes in CV and PV between pre-test and post-test.]
Procedural Values Pre and Post-test Based on Preservice Teachers’ Background

![Graph showing the change in procedural values pre and post-test based on preservice teachers' background. The graph includes two lines, one for non-math and one for math, indicating a decrease in values over time.]
Conceptual Values Pre and Post-test Based on Preservice Teachers’ Background.

<table>
<thead>
<tr>
<th>Background</th>
<th>Time</th>
<th>Means Conceptual Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-math</td>
<td>pre-test</td>
<td>7.6</td>
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<tr>
<td></td>
<td>post-test</td>
<td>8.8</td>
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<tr>
<td>math</td>
<td>pre-test</td>
<td>8.4</td>
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<tr>
<td></td>
<td>post-test</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Graph showing the mean conceptual values for non-math and math backgrounds, with increases observed between pre-test and post-test.
Predicting Equation from Regression Model

\[ \Delta CK = 0.26(HM) + 0.32(PK) - 0.5(CK) \]

Where
- \( \Delta CK \): change in conceptual mathematical knowledge
- \( HM \): level of high school mathematics
- \( PK \): procedural mathematical knowledge at the pretest
- \( CK \): conceptual mathematical knowledge at the pretest

\[ R^2 (0.35), 65\% \]
Discussion

Mathematics Methods Course

First Research Question

- Reform based approach
- Deepen content specific
- Improve conceptual knowledge
- Improve procedural skills
- Interaction between conceptual and procedural knowledge
- Shift of conceptual and procedural values from traditional to a more reform based approach
Mathematics Methods Course
Second Research Question

- Shift of conceptual and procedural knowledge and values from traditional to a more reform based approach
Mathematics Methods Course Third Research Question

- Number of university courses
- Mathematics background
- High school Mathematics courses
- High level of conceptual knowledge
- High level of procedural knowledge
Information Use

**Teacher Educators**
- Assess preservice teachers’ mathematical knowledge and values.
- Provide preservice teachers with more appropriate mathematical learning opportunities.
- Meet the expectations of the reform-oriented mathematics curriculum.
- Prepare preservice teachers before entering the classroom environment.

**Preservice Teachers**
- Identify weaknesses and strengths.
- Setting of personal goals.
- Develop the necessary mathematical knowledge to be able to teach in a reform-based approach.
- Engage students in solving mathematical problems.
- Increase students’ understanding of mathematical concepts.

**School Boards**
- Address the need for teacher professional development.
- Facilitate the transition of mathematics teaching from the old curriculum to the new reform-based curriculum.
Ongoing Work & Future Directions

- **Teacher Educators**
  - A final assessment in conceptual mathematical understanding which must be passed before the Bachelor of Education degree is granted has been initiated this year.

- **Preservice Teachers**
  - Based directly on these findings, two newly developed courses entitled “Mathematics for Teaching” are being offered to these preservice teachers in addition to the methods course.

- **School Boards**
  - At least three Ontario School Boards have or are using the POM instrument as part of an in-service teacher development program.

- **Ongoing Research**
  - Further work is under way with in-service elementary teachers to further unpack the development of conceptual mathematical understanding for teaching.
ACKNOWLEDGEMENTS

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Thank you