Improving Self-Efficacy and Academic Performance in Applied Mathematics II through Innovative Classroom Based Strategy: the Case of First Year Engineering Students at Jimma University, Ethiopia

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Outline of the presentation

• Background
• Statement of the problem : Why this study ?
• Theoretical framework and Intervention packages
• Methodology
• Results
• Implications
• Future directions
• Limitations
Background

- In education context students are expected to invest effort, participate and show perseverance in their learning.
- However, lack of interest and confidence, low motivation and disengagement are common among students. Such behaviors could be explained by the theory of self-efficacy (Siegle and McCoach, 2007).
Cont’d

- Mathematics self-efficacy is defined as belief of competency in engaging in mathematical problems (May, 2009).
- Students with a higher self-efficacy belief display adaptive behaviors manifested in: effort, participation, perseverance, challenge, faulty strategy, goals, motivation, different learning strategies and attribution (Bandura, 1993, 1989; Sewell and St George, 2000).
- Thus, educators need to think of strategies that could enhance student’s self-efficacy belief and academic achievement in mathematics.
Statement of the problem: Why this study?

- Scarce research in African context (Mwamwenda, 2009; Siegle and McCoach, 2007; Usher and Pajares, 2009)

- Little empirical evidence that show how college mathematics instructors enhance students’ mathematics self-efficacy and their achievements in a classroom (Usher and Pajares, 2009; Zeldin, Britner and Pajares, 2008)

- No single study that gives insight to policy makers and mathematics instructors on how to modify students’ sense of self-efficacy belief in a classroom setting and how students’ performance could be improved in Ethiopian context (Gebresilasse and Abebe, 2016; Geche, 2009).
Cont’d

• Thus, we test the theory of self-efficacy in Ethiopian context and show how the classroom based intervention strategy (promoting mastery experience, exposing students to role model, persuading students the importance of effort and creating favorable attitude towards a subject) influence self-efficacy belief and academic achievements.

• Provide mathematics instructors a viable approach of integrating the intervention strategy with the usual way of instruction.

• Consequently, we address the following hypothesis.
Cont’d

• \( H_1 \): Students who will receive the treatment (self efficacy enhancement strategy) will score higher on self-efficacy belief in applied math II than students who will not receive the treatment (\( H_1: \mu \) self-efficacy score for the experimental group \( \geq \mu \) self-efficacy score for the control group).

• \( H_1 \): Students who will expose to the treatment (self efficacy enhancement strategy) will score higher in applied math II than students who will not expose to the treatment (\( H_1: \mu \) academic achievements for the experimental group \( \geq \mu \) academic achievements for the control group).
Bandura’s theory of self-efficacy was used as

- it suggests ways of how to improve educational practices
- scores of researchers have shown the effectiveness of the various intervention programs in other settings
- clearly articulates the constructs of self-efficacy and posits how self-efficacy could be formed and modified in a classroom level (Anthony, 2012; Usher and Pajares, 2006; van Dinther, Dochy and Segers, 2011).
Intervention packages

- According to self efficacy theory, students’ self-efficacy is developed as students interpret their exposure with respect to mastery experiences, vicarious experiences, verbal persuasion and physiological and emotional arousal (Zeldin, Britner and Pajares, 2008; Zimmerman, 2000).
- Consequently, we develop an innovative classroom based strategy that could enhance students’ self efficacy belief and academic achievements in mathematics.
- The innovative classroom based strategy is basically adapted from Bandura’s theory of self-efficacy and existing literatures (Siegle and McCoach, 2007).
Cont’d

- We hypothesize that an integration of the innovative classroom based strategy with the traditional instruction is likely to have influences in students’ academic achievements and self-efficacy belief in math II as depicted in the figure below.
Cont’d

- Figure 1. Innovative classroom based strategy and its proposed influence on students’ academic achievements and self-efficacy belief in math II

  Innovative classroom based strategy.
  - Vicarious experience
  - Mastery experience
  - Verbal persuasion
  - Physiological state ..

  Academic achievements in math II

  Self-efficacy belief in math II
A classroom teacher is expected to implement the innovative classroom based strategy along with the daily traditional instruction in mathematics. The elements of the innovative classroom based strategy are depicted in table below.
Strategies

**Strategy 1: Mastery experience**

- Lesson review;
- Posting the daily lesson objective;
- Reviewing and checking objectives achieved in the daily lesson;
- Recording on a calendar something new students learned each day;
- Reinforcing students (could be privately or in group);
- Writing a specific feedback on assignment, class work;
- Prompting students who perform poorly to attribute their failures to lack of effort and encouraging them to try harder;
- Completing accomplishment plan (Students record goals achieved);
- Reviewing student's accomplishment plan at the end of the week;
Cont’d

**Strategy 2: Vicarious experiences**
- Peer modelling

**Strategy 3: Verbal persuasion**
- Encouraging students’ performance or ability to perform
- Orienting students continuously that they could master applied II with an effort

**Strategy 4: Positive Emotional experience**
- Comforting students during exercise, exam, telling them the type of exam
Methodology

Design

- An explanatory sequential mixed methods design was used: a quasi-experimental design followed by qualitative data was used.
- The study was conducted over four week periods in the second semester of 2015/16 academic year, in first year engineering students, Institute of Technology, Jimma University, Ethiopia.
Instruments

- **Self-efficacy belief**: A scale on self-efficacy measure contained 14 items was used to measure students’ level of self-efficacy belief in mathematics before and after the experiment. Students rate each item on a five point scale (1-Never; 2-Seldom; 3-Sometimes; 4-Often; 5-Usually) (May, 2009)

- **Mathematics Achievement II**: Students’ score in the mid exam was served as a pretest and the final exam was served as a post test.

- **Intervention Package**: An intervention package was adapted, piloted and used.
Cont’d

Procedures

- One instructor was selected. Then, orientation to the selected instructor was given on:
- how and when to do each component of the intervention packages,
- how to engage students effectively in mathematics instruction with the help of Student accomplishment plan and a calendar.
- registering the strengths, weaknesses, unusual or unexpected circumstances during the intervention and write any comments of the experiment on the prepared guidelines throughout the intervention phase.
Cont’d

• Experimental group = 63, Control group = 60
• Students in the experimental group were thought applied math II with instructional strategies containing self-efficacy intervention management for about 4 weeks (3 hours per week) by the classroom teacher while students in the control group were thought with the usual instruction.
• The actual performance for the mastery, vicarious, verbal and emotional experiences were 86%, 100%, 93% and 86%
Cont’d

Analysis

Quantitative Analysis

- Mean and independent t test were used

Qualitative analysis

- Qualitative analysis was conducted by transcribing and coding key data elements. Then, codes were merged to thematic areas.
Results

Quantitative findings

- Mean score on self-efficacy belief in mathematics between the experimental and control groups before the intervention

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>P</th>
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<tr>
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<td>3.62</td>
<td>.811</td>
<td>85</td>
<td>.252</td>
<td>.802</td>
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<td>.773</td>
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- Mean score on self-efficacy belief in mathematics between the experimental and control groups after the intervention

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<tbody>
<tr>
<td>Experimental group</td>
<td>3.67</td>
<td>.663</td>
<td>85</td>
<td>.626</td>
<td>.533</td>
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<tr>
<td>Control group</td>
<td>3.57</td>
<td>.773</td>
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- Mean score on academic performance in applied mathematics II for the experimental and control groups before the intervention

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<td>Experimental group</td>
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<td>6.485</td>
<td>121</td>
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<td>.336</td>
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- Mean score in academic performance in applied mathematics II for the experimental and control groups after the intervention

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<td>10.08</td>
<td>121</td>
<td>2.75</td>
<td>.007</td>
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<tr>
<td>Control group</td>
<td>18.19</td>
<td>13.06</td>
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</table>
• Pre test and pos test mean scores in academic achievement in applied math II for the experimental and control groups
Cont’d

Qualitative findings: Was the intervention effective?

• Almost all the discussants said that their academic achievement has increased. They also added that the intervention was important in influencing positively their academic achievements as there were discussions with their peer which immediately opens the door to clarify difficult contents and also timely feedback from the instructor was helpful to correct mistakes on time.
Implications

- This finding could have a practical significance for classroom instruction: enhance students academic performance.
- The innovative classroom based strategy could be taken as an important innovative pedagogy.
Future directions

• The applicability and generalization should be tested in other departments

• A research work is needed with follow up component to ascertain whether the improvement shown in academic achievement in our study is sustained or not.

• Finally, male and female students may base their source of self-efficacy belief differently. Thus, further study should be conducted to identify the self-efficacy sources for male and female students
Limitations

- Diffusion of treatment.
- Threat to internal validity.
- Limit the generalization of the study to other settings.
Thank you for your attention