The Impact of Post-Secondary Teaching Methods in Gen-Ed Math Courses

Dr. Wendy Hageman Smith
Longwood University

The Problem

- The way [college] mathematics is taught ... has not changed much over the past 300 years. [The] lecture-recitation method … remains the dominant style of teaching … (Levine, 1993).
- What sort of mathematics course should we offer our liberal arts students? (Briggs, W., 2004)
- … Undergraduate delivery of mathematical courses [is] founded more on tradition and habit than on any deep consideration of educational aims or extant research. (Barton, W. 2011)

On What Should Methods Be Based?

- The first tenets: All knowledge is constructed, is constructed from pre-existing knowledge structures and is recursive and dynamic.
- This suggests that classroom activities (discussions, worksheets, projects, etc.) provide the student opportunities to use, revise, and build upon previous knowledge. This suggests a very active type of learning that is also interactive.

Framework for Methodology (con't)

- The second tenet: Knowledge construction is inherently social in nature. This tenet suggests an atmosphere that is socially interactive, socially or contextually situated, and influenced by content area norms;
- This suggests a classroom environment in which students learn to emulate inquiry and communicate findings in the manner practiced by mathematicians.

Framework for Methodology (con't)

- The third tenet: Dialogue plays an important part in knowledge construction. What this tenet defines is a social learning atmosphere that is dialogue based.
- In the classroom, students and teacher(s) converse with each other about the mathematics concept, problem, or experiment being examined currently.

Framework for Methodology (con't)

- Dialogue may be defined as the extent to which classroom discourse resembles conversation. Conversation is judged by the extent to which students as well as the teacher contribute to the discussion, by the seriousness with which the teacher and other students treat others' ideas, and how the teacher and students build on demonstrated knowledge or revise knowledge structures during the conversations.
- With conversation the teacher is not the sole source for knowledge; each individual is provided the opportunity to communicate ideas.

Framework for Methodology (con't)

- The last tenet: Knowledge construction is contextually situated.
- What this suggests for the classroom is that mathematical tasks, projects, and assignments required from students should have different formats and contexts. This can take the form of worksheets, manipulative exercises, discussions, experiments, computer exercises, papers, or any other context that is suitable for the particular mathematics concept under consideration.

Framework for Methodology (con't)

- "Situated" refers to the environment where the activity is taking place, the project itself, and how the students work on the problem; a student working alone, working one-on-one with the teacher (or mentor) or another student, or a group of students.
- Just as one-size-does-NOT-fit-all, neither does one type of mathematics exploration work for all students for building substantive knowledge.

Summary of Framework

- These tenets suggest an atmosphere within the classroom. One might refer to it as playing. It becomes important for the teacher and the students to approach learning in the same manner they approach any active discovery; by playing.
- This playing can include playing with objects (as we have all done in any playground), or playing with the ideas presented in class, the content and the application of knowledge.

Putting It Into Practice

- **Any good mathematics exploration includes aspects from all the tenets.**
- The tenets imply the following operative questions for the teacher's analysis of his/her classroom:
- Is there opportunity in the classroom to form knowledge recursively? Is a student provided the opportunity to actively question, revise, and relate ideas in the classroom?
- What social structures exist in the classroom to make learning opportunities social?
- Is there dialogue in the classroom? Between/among whom is the dialogue? At what level is the dialogue?
- Are there learning opportunities in different contexts? What are the contexts? Am I exploiting as many different contexts and situations as possible?

Development and Validation of the Methodology (CU Boulder)

- Pre-research on classrooms for general-education mathematics.
- Patterns of the wandering mind exhibited in the students.
- What was going on?
- Ancillary research study – Math Anxiety (A feeling of intense frustration or helplessness about mathematics or about one's ability to do mathematics.)

Findings of the Study

- Competence (pre and post-tests)
- Attitudes (pre and post-questionnaires/interviews)
- Conceptions (or misconceptions) of Mathematics (pre and post-questionnaires/interviews)

ANCOVA results

- The treatment classes' relative increases in content pre-post test scores were somewhat higher that the non-treatment scores. (1.4:1.1)
- There was *no* significant difference between the pre- and post-questionnaire data for the non-treatment classes either for the attitudes or the preconceptions questions. However, there was a statistically significant difference between the pre- and post-questionnaire data for the treatment classes, both for the attitudes and the preconceptions questions.
- There were no significant differences that could be attributed to individual instructors. This is an important finding in that it appears the curriculum and application of theory had significant effects on student attitudes apart from instructor factors, no matter who in this sample of instructors applied the theory and how they applied the theory (as long as they included all tenets).

Conclusion

- The use of these methods for structuring the classroom environment and presenting the curriculum can affect student performance on content as well as their attitudes.
- Subsequent experience has borne out the value of the methodology
- Research is ongoing into the interaction of methods and student competencies in post-secondary general education math courses.

Dr. Wendy Hageman Smith

Longwood University Dept. of Math and Comp. Sci

smithwh@longwood.edu