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Winter 2009 Teaching Skills Study Award Report

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CONFERENCE TITLE: AMS-MAA Joint Mathematics Meetings (JMM) – Washington, DC
DATE: January 5-8, 2009
LOCATION: Washington, DC

Some Highlights of the Sessions

1. The role of discovery, writing, and reflection in mathematics education: "Covering material" vs. "discovering mathematics" – many of us wrestle with this dichotomy, and ultimately endeavor to strike a balance between the two. Writing vs. computing – many of our students believe that mathematics is computation, and they will have no need for writing skills if they teach math. It turns out that these two issues are closely intertwined – the math we discover must be communicated, and one of the main ways to communicate it is in clear writing. If a student cannot verbalize what s/he has discovered, it is likely that it is actually not clear in his/her mind. In the sessions I attended, some issues and important ways to help students discover math and write about it well were brought up, for example:
    a. Plan the course curriculum so it hits all the highlights, but perhaps forgo some of the less important content in favor of allowing more time for discovery.
    b. An enormous amount of time is needed to plan a "discovery" course, or the discovery component of the course, as one must consider carefully the knowledge with which the students enter the course, their math and writing skills, and their dispositions.
    c. For long and complex proofs, it can be very helpful to provide intermediate steps to the students. Be careful not to deprive the students of the opportunity to think hard, though!
    d. The discovery approach is diametrically opposite to the teaching styles most students have experienced throughout their schooling. While some students take to it like a fish to water, many resist this approach in its initial stages (or throughout the course.) We need to prepare students for the differences in the approach, and to be willing to weather their objections. Often students appreciate this approach only later – in fact, sometimes only when they themselves become teachers!

2. Education of K-12 Teachers: A particularly interesting talk in this area discussed the use of video cases to have pre-service teachers analyze the work of (K-12) students engaged in mathematical tasks. This talk was based on an NSF-funded project in which Dr. Bill Jacob (speaker) and Dr. Carl Lager are researching and writing a curriculum for a year-long course for pre-service elementary teachers. In this work they
    a. Focus on pedagogical content knowledge for teaching, stressing mathematical connections and development of mathematical ideas from the very basic to rather advanced.
    b. Emphasize context in fostering specific models and strategies
    c. Analyze case studies to understand the paths learners follow as they initially confront big ideas and strategies of the subject (distinct from adult learning)

    One of the issues that comes up is similar to those listed in #1 above: students are often reluctant to investigate context, and retreat to symbolic processes. Additionally, we see that these undergraduates have difficulty judging proximity of a child's (non-standard) approach to standard methods.

    Several of the ideas from this talk are very applicable to our work in our Liberal Studies courses, and I expect to be able to use ideas, and possibly parts of the curriculum itself in our courses.

3. Technology in the Classroom:

Geogebra This is a free resource for making geometry dynamic, understanding analytic geometry, and connecting it to topics in algebra, and I attended a mini-course on how to implement GeoGebra in the classroom. Since I already use Geometer's Sketchpad in my geometry classes, which is costly for students to purchase, I wished to learn how to use this free software package, and to determine whether it would suit the needs of our students – in geometry, and perhaps other classes. After attending this workshop, my conclusions are that

a. This is very nice software package. It is easy to use, and even a beginner can create important mathematical demonstrations in a short time. Students should find it very user friendly. It works on all standard platforms, and constructions may be saved not only in GeoGebra format but also as Java applets that can be used in any Java enabled browser. Thus they can also be used on computers that do not have the software installed.
b. The "feel" of the program is algebraic. It is quite straightforward to use for geometric constructions and algebraic concepts that are to be demonstrated on the Cartesian plane. GeoGebra can also be used to demonstrate "synthetic" geometric concepts, but for myself I prefer Sketchpad for this purpose.

Overall, I plan to recommend GeoGebra to my students, and to use it for demonstrations in classes such as math for Liberal Studies majors, College Algebra, and courses for the Master of Arts in Teaching Mathematics. Since this is a free resource, teachers will be able to access it easily in their classrooms, and to install it on student computers. In these days of budget cuts, it is particularly welcome to find an excellent program for mathematics that is also free!

ProofBuilder (written by Dr. Hugh McGuire) In another session, Dr. McGuire presented this software, which can be used to assist students to develop reasoning skills and assist them in learning how to write clear and accurate proofs. It too is free. After attending the session and trying the software, I have mixed feelings about this technology: it seems to provide rather too much guidance, and leaves the students insufficient opportunity for exploration and independent thought. However, trying out ProofBuilder led me to explore another technique developed by a high school teacher and presented at CMC-South: "Proof Blocks". The Proof Blocks are a (low-tech) way to guide students to thinking linearly and writing logical proofs, and I believe they will be an excellent resource for our students. I intend to use them the next time I teach a geometry class, and perhaps also with Liberal Studies students.