Integrating Math Education with Technology.

Bradley McMillan, REU Participant
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Abstract

With advanced computer software, Math Education has a chance to take advantage of new powerful opportunities. MATLAB is a powerful and versatile computing environment that provides many advanced mathematical features to the user. Using MATLAB in the classroom can allow students to explore the topics, both basic and complex, discussed in their textbook which they normally would not get to apply in a traditional classroom setting. Not only would they gain benefits from the increased in depth coverage, but they would gain experience using professional real-world software instead of using "toy" software. My goal is to attempt to create small modular lessons plans as examples for teachers to use, or they can expand upon the modules by customizing to meet classroom requirements. To create the lesson plans, I studied topic in learning theory based on using technology.
Introduction

I have 3 main goals for this research: provide enriching and educational experience for high school students to study mathematics, provide students with experience with professional real world software, and provide a computing environment encourages students to be creative while having their work properly assessed by the teacher. To accomplish these goals, I decided to make create modular lesson plans and use MATLAB as the professional software. The lesson plans are designed around issues concerning learning theory and technology. Research done in learning theory allows me to create the lessons that could be used in the classroom with only slight customization.

MATLAB is, according to their web site (http://www.mathworks.com/products/matlab/), "a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation." This software is flexible to meet state-wide requirements.
Modeling Lesson Plans

Tomei (2003) provides an eight step model for developing all the necessary elements for the creation of effective instructional units. The first step is preparing lesson goals and targets. Theme, grade-level appropriateness, lesson length, and focus are needed to determine the purpose of the lesson materials. The second step is specifying the learning objectives. Tomei creates the taxonomy for the technology domain based upon Bloom's Taxonomy. His six interconnected levels of literacy, collaboration, decision making, instruction, integration, and societal considerations provide an approach to thinking about technology-based student learning. The teacher must identify specific objectives for student mastery when creating learning objectives. He offers the ABCD format and Mager's behavioral learning objectives as two, widely accepted approaches for writing lesson objectives. ABCD is an acronym for audience, behavior, condition, and degree. Audience is the focus on the students who will use the lesson. Behavior deals with controlling what the students should learn, and what they should do to learn. Condition prepares teacher and the students with the necessary resources to aid in their learning. Degree or criterion determines the acceptable levels of performance in terms of quality, quantity or time. Mager's Model is similar to the ABCD model but has three major components: condition, behavior, and criteria. Conditions relate the circumstances, materials, and directions to the students. Behavior is a statement that describes what the learners will be able to do and the skills or knowledge to be gained. Criteria define what and how the students will be assessed. The third step is identifying material and resources. They do not need to be specific be should listed in categories such like text-
based and visual-based. The fourth step is to describe initial activities. These activities
set the stage for the material to be covered. The fifth step is the developmental activities
which cover a broader range than initiating activities. There should be at least one
developmental activity for primary objective. The sixth step is to engage in concluding
activities. These allow students to create meaningful summaries and make new ideas,
understandings, and connections. The seventh step is infusing technology. In this step,
the teacher decides on appropriate technologies that should be integrated in the classroom
activities. The eighth and final step is student learning evaluation. This step specifies the
procedures for how students will be assessed, and students should be allowed to use
forms other than formal pencil-and-paper tests.

My Lesson Plans

My initial design involved iterating through Tomei's eight step model. At step
one, I would focus mostly determining what students should for the lesson and if they
need to have done previous lessons before this one. Then at step two, I used Mager's
Behavioral Objectives to construct my learning objectives. I would answer four
questions:

"What must I give the students to in their learning of this content?"

"What do I want the student to know?"

“Who are the students that the lesson is designed to teach?"

"How well must the student learn the target material?"

At step three, I decided on resources I may need for the lesson. Since I am doing a
computer-based approach, I will probably mostly use visual-based and web-based
resources, but I could always literature and other types as well. Then I start developing introductory activities for the lesson at step four. Usually it will be a simple tutorial that gets them in the right direction. Then I design the activities to accomplish the lesson goals. Tomei recommends at least one activity for each primary objective to be taught.

At step six, I design a concluding activity. This activity should lead the students "in a meaningful summary of their discoveries and leads to new ideas, understandings, and connections." To accomplish this, I would design an exercise for the students that involves using the material they learned to perform an application of the new material.

At step seven, this is where I integrate technology into the lesson. The primary technology that will always be used is MATLAB. Other technology may be the Internet or forms of software. Finally step eight allows the teacher to evaluate what each student has learned. I propose having the students print out or save their copies of their MATLAB screens and their finished worksheets. MATLAB provides 2D and 3D visualization that can be helpful to students in preparing for the evaluation, but each teacher will decide individually how he or she wants to evaluate the students.

**Learning Theory**

After designing the initial layout of the lessons, I had to finish filling in the holes in the lessons. For this, I turned to Learning Theory. Berg (2003) offered some insight by using theories by Jean Piaget, Lev Vygotsky, and B. F. Skinner. Piaget's theory, a primary influence in constructivist theory, discusses how people progress through learning by interacting with their environment. That is why using MATLAB is important. It provides an environment where students can get instant response to
complex problems (stimuli) and therefore they can become better capable of
understanding complicated problems. Equilibrium and adaptation major principles to
explain the learning process through Piaget's theory. Vygotsky focuses more on social
interaction for learning. He proposed students learn better by interacting with each other.
I believe working with MATLAB individually is better than working in groups, but I do
think having small groups that can exchange questions and comments with each other
would be very helpful to the students. This can lead to positive effects in the classroom
such as more self-esteem and peer support. But too much social learning can lead to less
creativity hinder the students own interaction with the environment. B. F. Skinner was
the first behavioral psychologist to consider the use of computers in for education. In *The
Technology of Teaching*, he argues that it can increase better learning behavior. He
believed in reinforcing good learned behavior aided in learning. With MATLAB the
computer is able to reinforce the right answer immediately and the student is therefore
able to pick up what is being expressed to him.
Conclusion

I believe through reached my 3 main goals for this research. To accomplish these goals, I decided to make create lesson plans that use MATLAB as the professional software. The lesson plans were designed around issues concerning learning theory and technology. Research done in learning theory allowed me to work with lessons that could be used in the classroom with only slight customization. MATLAB is, according to their web site (http://www.mathworks.com/products/matlab/). "a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation." This approach and similar approaches should be studied more and applied to classrooms.
References
