

Sabbatical Leave Proposal For Fall 2003

John Golden

Observing, planning, teaching and incorporating computers in a standards based elementary classroom.

Goals and Objectives

- 1) Gain further experience in planning and teaching in a Standards-based elementary mathematics classroom.
- 2) Help plan, select and introduce a variety of computer software that will be incorporated into the mathematics curriculum at Aberdeen Tech/Math Academy. These applications will have a particular emphasis on geometry.
- 3) Document the results of (2) for publication. Either articles on individual lessons for *Teaching Children Mathematics* or *ON-Math*, and/or a more research focused articles based on assessment of the impact on student understanding of the technology.
- 4) Creation of vignettes and collection of examples of student work for use in Math 221 and Math 322, preservice teacher mathematics education courses with a focus on geometry.

Background

I am a latecomer to math education. My Ph. D. and training were in index theory and Von Neumann algebras. But while pursuing that degree and research I became involved in the mathematical education for preservice teachers, and an ever-growing interest in how people learn mathematics began. Hired by Grand Valley to, primarily, educate preservice teachers was really a dream job. I have since tried to avail myself of every opportunity to educate myself about mathematics education and to participate in K-12 math education. Towards this end, my relationship with Aberdeen Tech/Math Academy has been most fruitful.

When teaching Math 322, Geometry for Elementary and Middle School Teachers, for the first time, Dr. Jan Shroyer introduced me to Ms. Susan Walborn, Math Lab Director at Aberdeen. Susan was incredibly helpful in helping me guide my preservice teachers to fulfilling experiences.

Following that initial placement, we began what has been an ongoing and deepening professional collaboration and discussion. Finally last spring, we decided to collaborate on a Math/Art Fair, whose purpose was to unite the school in a single project, demonstrate the mathematics in art and vice versa, and to engage students in both substantive mathematics and art. It was an unqualified success. More than three hundred students were engaged and produced artwork. More than 200 returned with parents or family for an evening festival where peer selected works were on display and in competition for top ten awards, and more than twenty stations were set up for children and their family members to try activities which related art and math. We are currently planning the festival for 2003 and seeking a grant through the Michigan Council on the Arts to expand it. We are also in the process of developing the festival as a monograph for the Michigan Council of Teachers of

Mathematics. That experience led to being involved with the Aberdeen faculty and administration over the summer of 2002 in developing a model for inquiry based learning to be integrated across the entire curriculum

Project plan

The project centers on teaching mathematics with an emphasis on geometry to elementary students at Aberdeen Tech/Math Academy using computer software in the Fall semester of 2003.

The initial phase of this project has already begun, teaching one afternoon a week at Aberdeen to gain experience at that level of education and to informally assess these particular students' curriculum, mathematical needs and performance. This will continue through the Winter 2003 semester. In addition, in preparation for this proposal, I have begun the survey of research literature related to selection, introduction and assessment of computer software for and on children's mathematical understanding. The focus of the literature search in this phase is incorporation of software into discovery-based learning.

The next phase of this project is final selection of the software to be used, which includes piloting of Geometer's Sketchpad and Kaleidomania during the Math/Art Festival 2003 in May of that year. The focus of the literature search in this phase is assessment of the software's impact on the students.

The main phase of the project is to actually begin teaching using the software. Two days per week will be spent actually teaching at Aberdeen, with two days per week scheduled for lesson planning, collection and analysis of data, and recording of results for dissemination. This is in cooperation with Susan Walborn, Math Lab Director, and Chris Bengston, Design and Technology Lab Director. Currently students have time each week with each lab, in addition to mathematics and science lessons in the classroom. This project falls squarely between the two labs. Some of the computer time will be spent emphasizing the mathematics in the design and technology projects, using the software to further engage and develop the students in the design process. The focus of the mathematics addressed via software will come from the direction of the mathematics enrichment topics pursued in the math lab. The literature focus of this phase is to find articles on implementation issues and impact assessment related to what actually has happened at the school.

The final phase of the project is to assist and help with continued use of the software in Winter and Spring 2003, and to disseminate the results of the project to appropriate venues. To this end, I will continue to teach one afternoon per week at Aberdeen. In Winter 2003 I will be teaching Math 322, and will involve the preservice teachers in that course in design and implementation of a lesson using computer software to address geometry, and find first use for the vignettes and collected student examples of work. It seems very likely that the results of the project would be suitable for publication, and this is when appropriate venues will be determined and submissions made. Certainly there will be material for submission on particular lessons to *Teaching Children Mathematics* or *ON-Math*. Evaluation will have to be made of the data collected on student impact to determine suitability for publication in more research-oriented periodicals.

Timetable

Fall 2003:

Instructional time at the Aberdeen Tech/Math Academy, gaining familiarity with students' educational level, curriculum and mathematical needs. Preliminary investigation of research related to the project.

Winter 2003:

Continued instructional time at the school, including field service placement of Math 322 students. Begin to search for additional research articles related to the project, particularly those related to how to incorporate software into a discovery-based classroom.

Spring/Summer 2003:

Ms. Walborn and I will evaluate and choose the computer software to incorporate. Arrangements will be made with the school's information and technology supervisor to have installed and ready before the fall. Piloting of student use of Geometer's Sketchpad and Kaleidomania in the Math/Art Festival. Continued survey of literature, particularly related to assessment of the software's impact on the students.

Fall 2003:

Mondays and Wednesdays will be spent teaching at Aberdeen. Tuesdays and Thursdays will be devoted to planning individual lessons, examination of data and student performance, and recording of results and lesson plans for dissemination. Fridays will be flexible days allowing for more time in the school or on related projects.

Winter 2003:

Continued monitoring of students' performance and continued instructional time at Aberdeen. Additionally, I will involve Math 322 students in engaging children in computer based geometry lessons of their own design and incorporate the collected vignettes and student work in the course. Submission of results to appropriate publication venues.

Evidence of Preparation:

As noted in the previous sections, I have a deep and growing history of involvement at Aberdeen, and that actually includes the beginning of this project. On Monday afternoons I work with Mrs. Walborn in the math lab, where I have the opportunity to work with 1st and 2nd grade students in a discovery environment math class. I have also begun working with a group of kindergarten students in a project to address number sense through domino activities in partnership with six 2nd graders and six 3rd graders as teaching assistants. This is in cooperation with Ms. Chris Bengston, the Design and Technology Lab Director and Mrs. Georgia Ike, the kindergarten teacher, as well as Mrs. Walborn.

It does not take long to appreciate the outstanding mathematical environment at Aberdeen. Children have mathematics in their classrooms using Everyday Mathematics [7]. This makes Aberdeen the only elementary school in the Grand Rapids Public System using a

recommended curriculum by the US Department of Education Mathematics Expert Panel [8], or using one of the two National Science Foundation funded elementary mathematics curriculum projects. In addition to this, each class has an hour each week in the math lab where they participate in open-ended activities to enrich that curriculum. Furthermore Aberdeen is a citywide school with a demographic makeup closely resembling that of the Grand Rapids, resulting in a very diverse student body. And Mrs. Walborn is a terrific teacher, with impeccable classroom management and a deep practical understanding of how students construct mathematical knowledge.

We have made preliminary identification of the software to be used: Geometer's Sketchpad, some version of Logo, and Kaleidomania, as well as basic paint and spreadsheet programs. I have a great deal of experience using this software already. Further software is being researched, using evaluation guidelines much like those suggested by John Kerrigan in *Teaching Children Mathematics*. [3] The school has a large Macintosh computer lab capable of running any required software. Geometer's Sketchpad is already installed.

I have already begun looking for research on how to incorporate software into a discovery-based classroom, and how to assess its impact on students. Two articles by Battista and Clements, [1] and [2], have been particularly formative. They describe the enhancing of children's ability to experiment, conjecture and confirm using computer programs. Their work is directly responsible for the inclusion of several software titles in Investigations in Number, Data, and Space [6], an exemplary elementary mathematics curriculum as rated by the Expert Mathematics Panel of the U.S. Department of Education. [8]

The importance of involving this in my work in preservice teacher education is based on results such as that of Robert Quinn [5]. He details the necessity of preservice teachers involvement in using technology in math education courses, if we wish them to believe in the use of technology in their own classes. The desirability and use of technology in mathematics education is highlighted in the technology principle in the NCTM Standards, Chapter 2, p.26: "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." [4]

In summation, I feel I am well prepared to begin this venture. I have already become involved at the school in a small-scale version of what I propose, becoming familiar with and comfortable in the elementary classroom. Ms. Bengston, Ms. Walborn and I have demonstrated our ability to collaborate productively and Ms. Barbara Todd, the principal of Aberdeen, has demonstrated enthusiastic support for my involvement there.

Arrangements with people at other institutions

Attached please find letters of support from Ms. Chris Bengston, Ms. Barbara Todd and Ms. Susan Walborn.

Benefits to other units

There will be some tangential benefit to the School of Education through strengthened connections with a local school and increased opportunities for preservice teachers in mathematics.

References

- [1] Michael Battista and Douglas Clements, “Constructing Geometric Concepts in Logo”; *The Arithmetic Teacher*, Reston; Nov 1990; Vol. 38, Iss. 3; pg. 15-18
- [2] Michael Battista, Douglas Clements, Julie Sarama and Sudha Swaminathan, “Development of students' spatial thinking in a unit on geometric motions and area”; *The Elementary School Journal*, Nov 1997; Vol. 98; pp. 171-188
- [3] John Kerrigan, “Powerful software to enhance the elementary school mathematics program”, *Teaching Children Mathematics*, Feb 2002, pp364-370.
- [4] National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics*, 2000
- [5] Robert Quinn, “Technology: Preservice Teachers’ Beliefs and the Influence of Mathematics Methods Course”, *The Clearing House*, July/August 1997, vol. 7, No. 6, pp. 375-377
- [6] TERC, *Investigations in Number, Data, and Space Series*, Scott Foresman, 1997
- [7] University of Chicago School Mathematics Project, *Everyday Mathematics*, SRA/McGraw-Hill, 2001
- [8] The US Department of Education, *Exemplary and Promising Mathematics Programs Report*, Eisenhower National Clearinghouse, 1999