Case Study II – Antarctica Project

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Introduction

The Antarctica project was designed to create classroom activities that emphasize complex open-ended problem solving, communication and reasoning about mathematics, interdisciplinary and real world connections, and the use of technological tools for exploring relationships. “The group [MMAP] was seeking an active, process driven version of pedagogy that placed students and teachers in…activities that would be rich in conversations, mathematical activities, and resources.” While the project was successful in building teacher excitement and engagement of students in activities, it was realized that there were still a number of problems with the program outcomes. These problems included:

- Teachers perception that they weren’t covering enough formal math content.
- Students difficulty in making the connection between classroom activities and formal mathematics.
- The R & D team impression that teachers were missing opportunities to share mathematical concepts and make connections with the students.

Our task in this paper is to address what can be done in regards to the situation to improve on these issues and still maintain the exploratory environment. We will look at how the research and design team can address these problems from three different perspectives:

- How can the curriculum be improved?
- What can be done to help students link formal math concepts to authentic situations?
- What can be done to guide teachers in improving classroom interaction?

“…teachers thought they weren’t covering enough [formal] math content in the classrooms…”

One problem with the implementation of the MMAP curriculum was the fact that teachers did not feel they were teaching enough formal math content. In order to address this perception we suggest a twofold approach, first making the teachers more aware of the math content they are using, and secondly incorporating more formal math into the simulation activity. Making the relationship explicit between formal math and simulation activity is key to increasing teacher awareness of the connection embedded in the curriculum. One way to do this is to build standards into the curriculum and provide teachers with a booklet mapping the standards for their curriculum with the learning activities within the MMAP program. This booklet would include direct examples of standardized test questions and how they link directly to Antarctica project activities. This will help teachers understand what concepts and content are covered in the MMAP program and help justify the program to administrators and parents. In addition the development team could create a “cheatsheet” for each unit covering the concepts and formal math that are covered in that unit. It might also include sample questions and answers for teachers to use as a guide until they understand the connection and process more thoroughly. This “cheatsheet” will provide a guide to the curriculum that makes a concrete link between formal math and the activities. Another method to make teachers aware of math content in the simulation activities might be a phased approach where formal math is an integral component of the initial activities and then is gradually reduced until the teachers are more comfortable with the open-ended approach. This
approach will aid teachers in making a concrete connection between formal math and the Antarctica activities and the process would scaffold the teacher and students into the open-ended inquiry activities of the curriculum. Finally we feel there should be a mechanism for teachers to contact the research team when they are unsure of the formal concepts embedded within the MMAP program. The development team could provide guidance to teachers on the connection between the MMAP curriculum and formal math.

Incorporating some explicit formal math content into the MMAP activities is our approach to address the stated problem. The difficulty with this approach is that we want to add concrete activities to an open-ended problem solving and exploratory environment. The goal is to add math content without losing the discovery process. A possible solution is to keep the math opportunities as the primary source of unit activities, but add formal math as a supplementary activity. Developing a small formal component in the activities that occurs within the exploration will maintain the discovery process but increase math content. For example, design a formal proportion lesson as a follow-up activity to a proportion simulation activity. Have students answer a brief selection of questions and then have them journal and discuss any connections they see between the two activities. While the addition of a small formal math lesson might impede the discovery process, the journal reflections would reintroduce the open-ended nature of the activity.

“…students weren’t seeing the connections between the activities they were doing and the formal mathematics…”

Another concern of the research team is students’ inability to make connections between activities, formal mathematics, and the real world. We propose the addition of several curricular components improve students’ cognitive connections between formal math and real world situations. One method to address student cognition is to require students to keep a math journal where they will record, on a weekly basis, where they have used math outside of the classroom. Students will share their responses with the teacher and the class. Through this peer sharing, students will see how math connects to the real world. This may help students think about math in a personal way and relate it to their own experience. Journal questions should be provided by the designers as a help tool to teachers in guiding students to recognize math and write about it.

Another possibility for addressing this issue would be a debriefing session where after a MMAP activity each group would be responsible for explaining their strategy. As a class, with the teacher facilitating the discussion, students would share their process. With guided questioning this would be an opportunity for the teacher to build connections between the open-ended activities and formal math content. Through this process students will exercise and build their metacognitive skills.

A third possibility would be to have people in the math field come in to talk about math in the real world. For example, an architect could come in to talk about their work and how they use math in their job. Students gain an understanding of the authentic uses of math. This would also be an opportunity to demonstrate to students that a variety of jobs use and require math skills.

A final way to address the learning problem would be to involve students in homework or auxiliary assignments to take math outside of the classroom and involve parents in the process. For example, students would be directed to make cookies as a math assignment. During the process they will be asked to record measurements on a
homework page. They will then use measurements to do a proportion comparison, for example what is the proportion of white sugar to brown sugar? Additionally, after making the cookies, students will be asked to answer a small number of formal math questions concerning the proportions. This process could be scaffolded so that eventually kids are constructing their own “homework problems.”

“…R & D team felt that the teachers were missing the “math opportunities” model of the materials…”

The final concern for the development team to address is the teachers’ aptitude at recognizing and drawing out opportunities to extrapolate and build upon the math activities guiding students to higher levels of thinking about mathematics. To attend to this learning problem the development team could use a variety of professional development strategies. We suggest dividing teachers into cooperative teams where they share and exchange ideas and teaching experiences.

One strategy would be to create a system for observation where teachers will observe each other’s classes once a week for 30 minutes. They will focus on the question and answer dialogue that takes place around math concepts. Teachers will then meet to share observations and suggestions on question and answer technique to improve the quality of interaction. As a part of this observation system, classes can be video taped for teachers to view and share ideas about methods of interaction and coverage of formal content in a collaborative way.

A second idea would be for more experienced teachers to take on the role of a researcher within their own class in the model of action research. Teachers would formulate their own questions surrounding the MMAP activities and collect data to inform the answer to their question. Teachers could then share this information with other teachers and the research and development team to improve the design of the MMAP activities.

A final method would be for teachers to participate collaboratively in a MMAP activity prior to its implementation in the classroom. By going through the activity teachers will have an understanding of the types of problems and questions students will encounter, thereby informing the actual implementation in their classroom. Following the class activity, teachers will share their insights on student concept development with each other. This process will help teachers anticipate student outcomes and questions and be aware of opportunities to extrapolate math content.

**Conclusion**

In this paper we have addressed the learning problems faced by teachers and students in the implementation of the Antarctica Program. We feel that through these suggestions the connections students are making between formal math and real world situations can be improved. Our ideas will help teachers create mathematical opportunities and promote in-depth mathematical conversations, activities, and arguments within the classroom. In reviewing this case, it seemed clear that it is difficult to make the transition from traditional classrooms and math activities to an open-ended inquiry system. Only through practice, experience, guidance, continued research and development, will the system evolve. It takes time for teachers and students to become
comfortable and adept at new systems. With time and new curricular activities the connections will improve.