**Background and perspectives**

The supply of qualified, competent mathematics majors entering secondary teaching professions is not keeping pace with demand (Liu et al., 2008; National Research Council, 2002). According to Ingersoll and Perda (2009), the problem is more than a number game. Part of the problem resides in the fact that teachers are not happy with the profession once they are out in the fields, causing the number of teaching leaving the profession to be greater than the number of teachers entering the profession. This is especially the case in low-income areas where they are 77% more likely to be taught by out of field teachers compared to students from high socioeconomic backgrounds (Ingersoll, 2003). Attrition is also a compounding factor as recent research reveals 20 to 30% of teachers have left the profession within the first five years (Darling-Hammond, 2001).

The NSF Robert Noyce Scholars Program seeks to help address these issues through a scholarship program aimed at recruiting and retaining secondary mathematics teachers for high needs school districts. Districts experiencing high teacher turnover rates, teachers teaching in areas outside of their content area, and high poverty rates all meet the condition of high needs for this program.

Specifically, this preliminary report discusses how the Rocky Mountain Noyce Scholars Program (RM-NSP), a five-year National Science Foundation scholarship grant for undergraduate pre-service secondary mathematics teachers, aims to target undergraduate education as part of the solution. The central tenant is that if we recruit teachers who are strong in their content area and also dedicated to serving students in high needs school districts that the attrition rates may decrease. If we also help prepare and support our teachers well (both in the areas of mathematics and pedagogy), they will hopefully have high job satisfaction rates and be effective classroom teachers.

Adhering to these ideals in the undergraduate education of pre-service secondary mathematics teachers, the RM-NSP has been a catalyst for revision of the undergraduate secondary mathematics teacher preparation program. We discuss one component of this revision in detail in conjunction with preliminary results from the first year of the program. In our presentation, we will seek advice from our audience members on future research steps and data collection to strengthen the preliminary results.

**Program, participants, and context**

A novel component of this revision is a college internship experience for the pre-service teachers. The idea for this project was adapted from Hodge's (in press) idea of a Teaching Algebra Seminar. This was part of the goal of having the pre-service teachers experience teaching not only at the level they eventually plan to teach at, the secondary level, but also at the level beyond, namely introductory college courses. We thought that this experience would provide them exposure to common algebra misconceptions, experience facilitating guided problem-solving groups, deeper involvement with the university and the Department of Mathematical and Statistical Sciences, a deeper knowledge of the algebraic and geometric reasoning skills students need for success in trigonometry, and an exploration of historical importance of trigonometry.

During this internship, they act as recitation instructors for a section of college trigonometry. This is an optional, but highly attended, one-hour session before each hour of lecture. It should be noted that prior to this program, recitations were not held for college trigonometry classes at this university. During the pilot semester of this, 6 pre-service teachers participated. They were grouped into threes based on their individual class schedules and placed into two recitation sections. Both sections had the same instructor for the lecture portion of class – a full time instructor from the Department of Mathematical and Statistical Sciences. During the pilot, the pre-service teachers did not receive any credit for the experience. Rather, it was a condition of accepting the scholarship, and for two of them, a volunteer experience.

Duties of the recitation instructors included: attending lectures by the instructor, leading associated recitation sections, designing activities, handouts, and review activities, working with students on an individual basis, grading and providing feedback on student work, facilitating technology-driven application problems and attending a weekly seminar on teaching trigonometry.

**Data collection and data analysis**

Since this was a pilot study, some of our outcomes were unexpected and data collection went beyond what we had anticipated. We were attempting to gather data on the impact of the recitation program on the pre-service teachers. However, early in the semester the instructor began noticing changes in the performance of the trigonometry students compared with previous semester. We monitored these changes throughout the semester. The instructor also began to observe changes in his approach to the class, and began to consciously reflect on this. In future semesters, we would like to pursue these effects in more depth and with more intentionality of research design. We will seek input from the audience on how to best research the input on the trigonometry students and on the instructor's changes in practice.

As we began to notice changes, we began to collect data in multiple ways. First, we collected scores of the trigonometry students on each of their three exams and the final and compared theses to prior semesters of trigonometry taught by the same instructor. Once we noticed the significant increase in performance on the first exam, we began to intentionally gather data on the remaining exams for comparison purposes. The instructor also began to pay more attention to how the experience was affecting his teaching. The external evaluator of the grant interviewed him about this experience and its impact on him. A large part of our desire to give this talk is to solicit audience input on how to more methodically pursue our investigation of this trigonometry internship experience.

**Preliminary results of programmatic change**

One of the first outcomes of this that we noticed was that scores by the trigonometry students were considerably higher than they had been in past semesters. Specifically, the median score on each exam increased by 8-10%. This is a comparison among college

trigonometry classes taught by the same instructor at the same university. The instructor considered the exams very similar each semester, with the Spring 2010 exam actually more difficult. We will be having a group of "experts" look over the exams to see which ones they would consider more difficult.

Additionally, the class has three technology-driven application problems. The application problems require the students to synthesize their knowledge of the material and apply mathematics to real world scenarios. The percentage of students who completed these went up considerably with the implementation of the trigonometry recitation sections, from approximately a 75% completion rate to a 100% completion rate

In addition to impacting both the trigonometry students and the pre-service teachers, we found that this class had a significant impact on the instructor. In an interview with the external evaluator, he reported a renewed focus on conceptual understanding of the material, consistent feedback and insight from recitation instructors, a deeper understanding of individual trigonometry student's strengths and weaknesses, and a greater understanding of the historical background of trigonometry and its connections with other fields.

**Discussion and implications**

Some of the noted impacts could be explained simply by the fact that students who have more support in classes can be expected to perform better. However, the magnitude of these changes seems to indicate that something more is occurring. There is walk-in tutoring available for all of the lower level math courses in the Math Education Resource Center, staffed by undergraduate and graduate math students, and there are recitation sessions available for other lower level math courses, specifically College Algebra and Calculus I. Neither of these support structures seems to have the same impact on student achievement.

Some questions that arise and may be good for discussion include:

1. How can we better analyze what is leading to this improvement in student achievement in trigonometry?
2. Can this internship be leveraged to impact student achievement more broadly in the lower level math classes?
3. Does the impact on the instructor transfer to increased student achievement in his other lower level classes? If so, how could this be measured?
4. How might we isolate the components of this internship that are central to the increase in student achievement?

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