Session Title:
Impact of the Poincaré Mathematics Project on Teacher Instruction

MSP Project Name:
The Poincaré Institute: A Partnership for Mathematics Education

Presenters:
John Zuman, INCRE
Ana Lucía Schliemann, Tufts University

Authors:
John Zuman, INCRE

Project Session

Strand 3

Summary:
This presentation begins with a brief overview of the Poincaré Mathematics project, with a focus on how this on-line targeted MSP institute engages teachers in classroom applications of Algebra concepts and promotes discussion of instructional strategies. The presentation will then examine how the on-line course pedagogy has impacted teachers’ instructional strategies. We will present results of pre-post and follow-up class observations of the Algebra lessons of 48 teachers who were part of the first Poincaré cohort. Findings include impacts on teachers’ questioning, types and extent of student-centered activities and level of student engagement. The presentation will examine how long it takes for instructional effects to take hold in teachers’ regular classroom practice. Audience participation will be encouraged.

Section 1: Questions framing the session:
1. What on-line pedagogy does the Poincaré Institute utilize to promote reflection and discussion of teachers’ instructional strategies?
2. How successful is this on-line course pedagogy in affecting teachers’ practices in the classroom?
3. In what ways has participation in the Poincaré Institute impacted on teachers’ Algebra instruction?
4. How long does it take for the effects of Poincaré participation to have an observable effect in the classroom?

Section 2: Conceptual framework:
This presentation is related to Conference Strand 3: Research & Evaluation. Our conceptual framework postulates that participation in the Poincaré Institute, a three semester graduate course intervention for grades 5 to 9 teachers of mathematics, will enhance teachers’ understanding of key concepts, and will affect and enhance their instructional strategies, which in turn will lead to increased student understanding of Algebra and other topics in the middle school curriculum. This presentation focuses on
the relationship between the pedagogy component of Poincaré and the resultant changes in teachers’ instruction.

The Poincaré Institute’s interdisciplinary team adopts the view that the teaching and learning of mathematics should unfold from children’s basic logical and mathematical understandings, emerging from contextualized everyday or science situations, and should lead to more general, complex, and explicit content knowledge of mathematics and its multiple systems of representation. To that goal, our course materials focus on promoting teachers’ deeper understanding of (a) mathematical content and their multiple representations and (b) students’ ways of approaching specific mathematical content, as documented by mathematics education research, videotaped classroom demonstrations, participant teachers’ own interviews with students, and teachers’ own classroom observations. The mathematical content of the courses adopts a functional approach to arithmetic and algebra that can lead to a deeper understanding of topics in the mathematics curriculum for grades 5 to 9, such as arithmetic operations, fractions, ratios, proportion, geometry, and algebra.

Section 3: Explanatory framework:

A total of 48 Cohort 1 Poincaré teachers were observed during the first month of the Institute in January 2011, then again one month before the end of the third course more than one year later in April 2012. 28 of these teachers were observed again six months after the end of the Institute in October 2012. All class observations were conducted by experienced mathematics education researchers using an analytical observation instrument and the RTOP. Findings from post-Institute observations found modest changes in teachers’ instructional practices as a result of Poincaré participation. However the follow-up observations showed much more significant changes in teachers’ instructional practices, after the teachers had the summer and additional time to absorb and implement the lessons gleaned from Poincaré participation. A key lesson is that there was a lag between participation in the Institute and significant observable effects on teachers’ instructional strategies.

This trend is illustrated in the Reformed Teaching Observation Protocol (RTOP) ratings. The mean total RTOP rating for the 48 Cohort 1 teachers at the January 2011 baseline was 43.50 on the 0-100 point RTOP scale. At the end of Course 3 in April 2012, after approximately 500 hours of instruction, the mean total RTOP rating for the group increased modestly to 49.64. However a subset of 28 of the 48 Cohort 1 teachers was observed again in October 2012, six months after the completion of the Institute. The mean total RTOP for this subgroup was 38.78 at the baseline, 47.54 in April 2012 and 56.57 at the 6-month follow-up. These data suggest that teachers incorporated the instructional strategies taught by the Institute in the months after they completed their training.

The specific changes in instructional strategies reported by teachers in follow-up interviews were reflected in the ratings of specific RTOP items. Among reported and observed instructional changes are greater use of graphing, visual models and hands-on activities; greater use of technology; greater and more skillful use of student dialogue and
questioning; more real life connections, and connections with Geometry and Physics; and increased focus on student reasoning and problem solving.

The 28 teachers included in the follow-up interviews and observations were not self-selected, but included all teachers who taught in the same schools as teachers selected for Cohort 2. There was no significant difference in the mean RTOP ratings for this group of teachers and the 20 who were not included in the follow-up.

**Section 4: Discussion:**
The MSP logic model is predicated on the assumption that providing training, professional development and contact with university faculty for school teachers will lead to improvements in student achievement in STEM subjects. This presentation focuses on the relationship between the pedagogy component of the MSP intervention and the resultant changes in teacher practice. Our work will continue by examining how changes in teachers’ instructional practices lead to changes in observable student learning variables such as level of engagement, time on task, motivation, questioning and discussion, which in turn may lead to measurable increases in student understanding and achievement. The reported results will also be utilized by the Poincaré course design team to inform possible enhancements in the pedagogy component of the on-line courses. Since all MSP’s strive toward a common goal of enhancing student learning through teacher-focused interventions, we hope that our findings will be of interest for other MSP’s.

**Section 5: How will you structure this session? What is your plan for participant interaction?**
In the first part of the presentation, Poincaré co-PI Schliemann will familiarize the audience with the project and will briefly highlight the strategies that the project has utilized to help teachers apply course content to inform discussions about teaching and learning strategies. This will be followed by a summary of the classroom observation methodology and the results of pre-post and follow-up analyses conducted by the project evaluation team by Poincaré external evaluator Zuman. We will also briefly discuss how these results on teachers’ regular classroom practice compare to the lessons they produced as part the Institute’s formal course requirements. Zuman and Schliemann will then explore with the audience how the reported results compare with those of other MSP’s and will ask participants to share relevant experiences in an informal Q&A format.