Mentored Professional Development to Support Successful Integration of Technology-enhanced Science Curriculum

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Abstract: MODELS (Mentored and Online Development of Educational Leaders for Science) is a 5-year NSF grant funded to support teacher professional development and learning to enable schools to implement technology-enhanced inquiry instruction. In this paper we discuss professional development activities, classroom enactment of technology-enhanced projects, and the trends emerging in changes in teachers' beliefs and practices during the first two years of the project. We present a case study of one teacher's learning progression and discuss plans for further data collection and analysis.

Inquiry-based science learning and teaching can be enhanced by the use of technology in the classroom (Bransford, Brown, & Cocking, 1999; Linn, Davis, & Bell, 2004). However, integration of inquiry-based science curricula and technology integration is difficult for many teachers. Effective professional development programs that are flexible to adapt to the needs of teachers, schools, and communities (Borko & Putnam, 1995) and are sustainable contribute to successful integration (Davis, 2003; Fishman et al., 2003; Grossman, et al., 2001; Little, 2002).

MODELS, Mentored and Online Development of Educational Leaders for Science, is a 5-year NSF grant funded to support teacher professional development and learning. The program was designed to enable schools to implement technology-enhanced inquiry instruction by means of a sustainable professional development program that is customized to their needs. MODELS aims to improve both science understanding and practice of teachers through the development of peer-mentoring communities. Teachers and mentors receive professional development opportunities at summer workshops and mentor meetings and are encouraged to discuss their experiences in face-to-face and online collaborative activities. Activities are designed to support teacher collaboration, to stress reviewing student work, and to support teachers' customization of the curriculum and their teaching. We are in the second year of this 5-year grant, and are examining how teachers' beliefs and practices are changing from Year 1 to Year 2 as a result of the professional development.

Methods

Participants

Participants include 18 middle school science teachers from two schools in separate districts who are integrating technology-enhanced projects into their curriculum.

Learning Environment

Teachers use projects created in the Web-based Inquiry Science Environment (WISE) a free online science learning environment for middle and high school students (wise.berkeley.edu). Projects engage students in various collaborative activities, such as designing solutions to problems, debating science topics, investigating hypotheses, and critiquing scientific claims.

Data Sources

Summer Workshop Teacher Comments

During each summer workshop teachers responded to questions posted online that asked them to reflect upon the professional development activities, their teaching and learning, the implementation of the projects during the upcoming year, and future professional development activities that could be useful.

Classroom Observations

University researchers observe teachers and students at various times when teaching with a WISE project. Observations are recorded on an observation form containing specific categories: general interactions, working with simulations, small group interactions, and mentor support.

Teacher Interviews

Following the completion of each project, university researchers interview teachers about their experiences. Questions focus on connecting ideas between the project and the rest of the curriculum, teaching with the models/simulations, effectiveness of teachers' customizations, assessment/feedback to the students, and types of mentoring/support received and wanted for the next WISE project.

Procedures

Year 1

During the summer, teachers attended a workshop for 5 consecutive days on the university campus. Teachers were introduced to WISE projects, they selected projects to run in their classrooms, and they planned and set goals for teaching with the projects during the upcoming year.

During the school year, all teachers ran at least one WISE project in their classroom. A university-based mentor was present during the first day to offer support and to help the teachers get started and often provided additional support during subsequent days. One teacher who had previously run WISE projects in her classroom acted as the school-based mentor for School 1. She visited teachers' classrooms when her schedule permitted and provided technical support to the teachers. She often acted as a liaison between the teachers, the administration, and the university researchers. All teachers from School 2 were new to WISE projects, so they relied on the university mentors rather than school-based mentors for support.

Year 2

Teachers attended a summer workshop for 5 consecutive days on the university campus. Teachers reviewed their previous year experiences with WISE projects, discussed teaching practices, and selected and customized projects to be used the following year. The university researchers provided teachers with samples of student work and prompted teachers to use this data to make evidence-based decisions about changes in teaching practice and project customizations. Researchers also led discussions about teaching strategies for teaching with models and successfully integrating projects into the larger curriculum.

The school-based mentor from School 1 remained the same, and a mentor was selected for School 2. Mentors met for 2 days on the university campus. They reviewed WISE projects, discussed teaching and mentoring strategies, shared WISE experiences, and planned for the upcoming school year.

17 of the 18 teachers have run or are scheduled to run more than one WISE project in their classroom in Year 2. The school-based mentors are meeting with teachers before and/or during project runs to offer assistance. They provide the majority of support for the teachers at their school while university researchers support the school-based mentors, but are available to provide support to teachers if requested. The mentors continue to act as liaisons between the teachers, administrators, and university researchers.

Preliminary Results

Preliminary analyses of summer workshop data, classroom observations, and teacher interviews reveal some emerging trends in changes in teachers' beliefs and practices. We use one teacher, Rachel, as a case study to provide examples of these emerging trends and to demonstrate her learning progression.

Data reveal that on average teachers are more confident Year 2 using the technology. During the first year, teachers relied on university researcher support to use the technology on the first day and when troubleshooting technical issues. Teachers worried about if the technology would work and their abilities and their students' abilities to use it correctly. During a post-run interview in Year 2, Rachel commented:

> Last year and a little bit this year also, I was more concerned about the mechanics of it, of the programs and which button do they push, what the screen looks like, scroll down and save your work. And I feel like they're getting the hang of it. I feel like next year I don't need to stress that as much and now I know which concepts I need to stress…We can talk more about what we're teaching than the I-Books. Now we're using it (the technology) more than focusing on it. I mean it's exactly the way the evolution should be.

In Year 2 teachers are able to focus more on the science content, students' understanding, and their teaching practices rather than on the technology. Rachel recognizes this as a natural learning progression.

In general, in Year 2 teachers are better able to use student work to inform their teaching practices. This was something that was prompted at the summer workshop, and Rachel reported, "I liked having the time to really think about how well my students integrated the ideas in the mitosis project. It was helpful to have time to discuss the data with Danielle and come up with ideas about where the gaps are. We have revised the project, and made a plan for how to change the way that we teach it." She also stated in a post-run interview that "going the second time is so much better because I know exactly where they're going to have problems and where they're not going to have problems." The teachers were able to use the evidence provided in their students' work to determine where the students had trouble understanding the content and made plans on how to account for these challenges.

Teachers also demonstrated much more use of student work *during* project runs to inform their teaching. During Rachel's Year 2 post-run interview she revealed, "last year on this project I may not have even done openers. I don't think I was doing openers except for if I felt like I really needed one…this year I did them most of the days." This year Rachel made it a priority to look at student work several times during the project run to determine her students' understanding. She created openers, which were daily discussion questions or topics related to what she found her students were having trouble understanding. She said,

> I create the openers after I've looked at the work. And I designed them to try to correct misconceptions or help them with something that they're struggling to understand. I don't know that I'll use the same openers myself next year. It all depends on where they are. What point did they get to in the project that day and then that night I'd look at it and what kinds of issues are they having…I feel like it's important, but I feel like they're useless unless you're catering them to exactly what the kids need at that point.

This reveals that Rachel has learned the importance of evaluating student work during project runs to assess students' understanding, so that she can provide the guidance needed to grasp the science concepts.

These preliminary results are promising and suggest that the professional development is contributing to positive changes in teachers' beliefs and practices. Additional teachers will be observed and interviewed during Year 2 and compared to Year 1 data, which will also allow us to create teacher trajectories that can be tracked over time and compared across settings. We will share these additional findings at the conference and facilitate a discussion on designing collaborative professional development opportunities to support successful integration of technology-enhanced curriculum.

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