EVALUATION OF PROFESSIONAL DEVELOPMENT PROJECTS

Missouri Department of Higher Education

Improving Teacher Quality Grants

Cycle 3 External Evaluation Report

Executive Summary

MU Science Education Center
University of Missouri-Columbia
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Introduction

The current educational policy climate in the US and in Missouri is focused, in part, on producing high quality teachers for our schools. Too many classrooms are taught by individuals who are not certified in the subject matter they are teaching. The problem of highly qualified teachers is acute in the areas of mathematics and science, where many teachers have less than adequate preparation in content and pedagogy. Effective professional development (PD) for mathematics and science teachers is one solution to the problem. The *No Child Left Behind Act* provides funds to the Missouri Department of Higher Education to institute a program of PD in mathematics and science education.

There is a great deal of agreement about what characterizes effective professional development in mathematics and science education (Loucks-Horsley et al., 2003). Research and policy documents agree that effective PD is long term; involves ongoing collaboration of teachers in planning; is anchored in student learning, curriculum, and pedagogy; and has an explicit goal of improving student learning. Effective professional developers model the kinds of reform-minded instruction that is expected of classroom teachers in order for teachers to build their content and pedagogical knowledge. Effective PD requires the collaboration of schools, universities, and other entities in supporting teacher growth in knowledge and practice. The ultimate goal of PD is to improve student learning.

Overview and Methods

The purpose of the External Evaluation Report is to summarize the evaluation of the nine PD projects funded by Cycle 3 (2005-2006) of the Missouri Department of Higher Education (MDHE) *Improving Teacher Quality Grants* program. The evaluation is based on data collected by the external evaluation team in cooperation with project directors. The external evaluation team collected data about the context of the projects (PI background, project design, participants, and their schools). Secondly, we conducted formative evaluation in the form of site visits to each project's summer institute and follow up activities. Finally we conducted summative evaluation using a variety of instruments at several times throughout each project.

The full report provides demographic data about who the projects served, results related to program objectives across the nine projects, and individual project summaries and data tables. The report also responds to seven guiding research questions and provides recommendations for future funding cycles.

Results

The following evaluation summary is organized around the evaluation research questions that guided Cycle 3 external evaluation.

1. *What are the characteristics of the funded PD projects? How much variation and similarity exist in philosophy, assumptions, and methods? To what extent do projects achieve goals?*

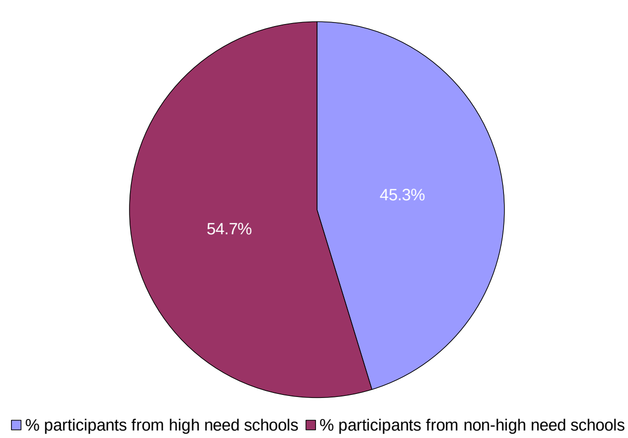
The Cycle 3 PD projects were based on PI beliefs about teaching and learning which emphasized student-directed and inquiry-oriented instruction. The projects featured the following common delivery mechanisms: 1) held 2-3 week summer institutes, usually on college campuses, that engaged teachers in activities that their students might do in classrooms, and often included technology (exceptions were MSSU, which ran many 2-day workshops during the summer, and UMSL, which ran Saturday workshops in June and July); and 2) awarded graduate credit (exception was MSSU). Projects were more varied in the form and quantity of school year follow-up activities. Unique project follow-up features included a meeting via distance technology, online video discussions via web-based technology, and individual classroom visits with feedback from the PD project team. Projects emphasized learning both science and mathematics content and pedagogy, but most projects did not demonstrate connections between the content being learned, the curriculum in place in the participating schools, and the instructional and assessment methods that could facilitate student learning of the content.

Overall teachers were satisfied with the PD projects and believed that project PIs/staff achieved their goals. When asked what they valued most about the PD projects, respondents mentioned a range of components, including the quality of the instructional staff, the opportunity to engage in science or mathematics activities like students, improving their science or mathematics content knowledge, and working with other teachers. When asked what they valued least in the PD projects, common themes included that they did not like to be lectured to; they did not prefer activities not directly related to the content/level of their teaching assignments; and they did not appreciate follow-up sessions when they were loosely structured and did not have a clear purpose.

2. What are the characteristics of the teachers who participate in the PD projects?

Cycle 3 PD projects served a total of 252 participants, including 239 teachers, 7 pre-service teachers, 3 paraprofessional, and 3 administrators. One individual participated in two projects. Teachers came from 76 different Missouri school districts, 6 private schools, and 2 charter schools and directly impacted 16,747 students in the 2005-2006 school year. Fewer than 49% came from districts designated in the Cycle 3 RFP as high-need districts.

Percent of Participants from High-Need Districts (n=252)



The Cycle 3 participants can be characterized as follows:

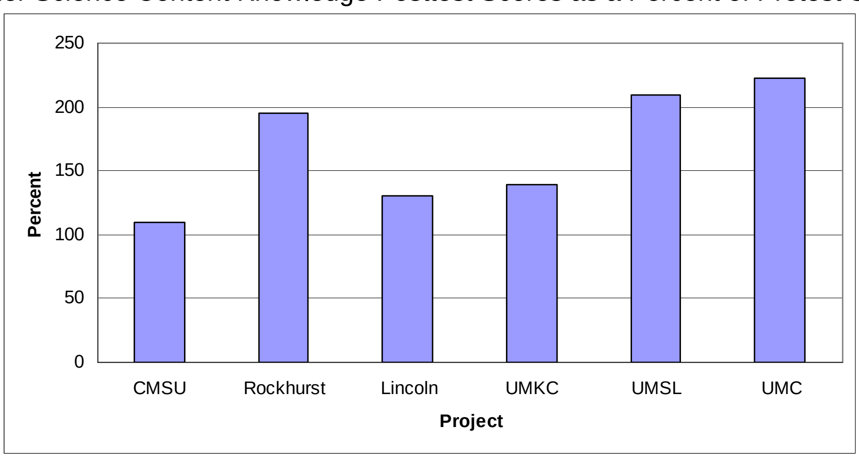
- 81.6% were white;
- 86.3% were female;
- 40.4% held a Master’s degree or higher, 58.7% held a Bachelor’s, and 0.9% had no degree;
- 2.4% held their highest degree in a field other than education;

- Most had fewer than 10 credit hours of mathematics or science content coursework in their undergraduate degree program, and no mathematics or science content coursework in their graduate degree program;
- Most (n=141) held certification in elementary/early childhood education (127 of those were regular certification and 14 were provisional or temporary); 136 individuals were certified in middle level mathematics or science (113 of which were regular certification); 78 were certified in high school mathematics or science (77 regular certification).
- A large group of participants had 1-5 years of teaching experience overall (n=34), while many other participants had fewer than 6 years of experience at their current district (n=47) or current school (n=54);
- Most participants taught at the elementary school level, with the next biggest group middle school general science teachers;
- 79.0% were teaching at the same school as in the previous year;
- Most had participated in fewer than six hours of PD in mathematics or science education in the three years prior to Cycle 3, and only 14.1% reported participating in web-based PD in the prior three years;

3. *What teacher learning outcomes (knowledge and understanding of science concepts, knowledge and understanding of inquiry-based pedagogy, and changes in teacher practices) are demonstrated in the PD projects?*

Science content knowledge assessments were administered as pretests and posttests to participating teachers in six of the Cycle 3 *Improving Teacher Quality* PD projects. Results from four projects indicated that teachers' tested science content knowledge increased from 6.1% to 38%; the average was 17.8%.

Teacher Science Content Knowledge Posttest Scores as a Percent of Pretest Scores



Teachers' self-reported ratings of knowledge in each of the science content standards targeted by the PD projects increased more than one scale point in physics topics (about a 25% increase) and nearly one scale point in the living systems domain (a 12 % increase). Some teachers commented that the science concepts they were asked to master during their PD experiences were above and beyond the knowledge they would be teaching their students. Some PD project PIs/staff considered such comments to indicate that they successfully challenged the teachers' knowledge horizons and improved teachers' confidence to teach difficult concepts. However, because many projects relied on self-reports of teacher learning in place of data from science content knowledge assessments, the results are incomplete. No project reported data on teacher mathematics content knowledge.

Teachers reported that their knowledge of active inquiry-based practices increased. The level of knowledge about these practices as reported by teachers at the end of the project (about 7 on a 10-point scale) was about 1.5 points higher than the average rating at the beginning of the projects.

Teachers reported "some" to "quite a bit" of improvement in teaching practices associated with most components of PD listed on the *Teacher Participant Survey* (even when a component was not reported by PIs as part of a particular PD project). Components with a self-reported impact of "quite a bit" or more on teaching practice included: creating inquiry-based classrooms and using inquiry-based teaching.

Teachers' responses to the *Teaching Philosophy Survey* showed that most participants began PD with some tendency towards constructivist beliefs and there was little change in deep-seated beliefs about how students learn best or how instruction should be delivered at the end of PD. In relation to *Seven Principles of Practice,* teachers reported that their use of all principles increased after their participation in PD projects.

4. *What are the relationships among project characteristics, teacher characteristics, and teacher learning outcomes*?

PD outcomes are related to a host of design and implementation factors. However, a causal sequence from design to implementation to outcomes is difficult to document. In this report, we described the context, processes, and outcomes within and across nine PD projects. The projects that were most successful had cohesive instructional teams, linked science content with pedagogical issues, spent more time in purposeful follow-up activities including classroom visits, and provided other supports in the form of equipment and/or curriculum materials.

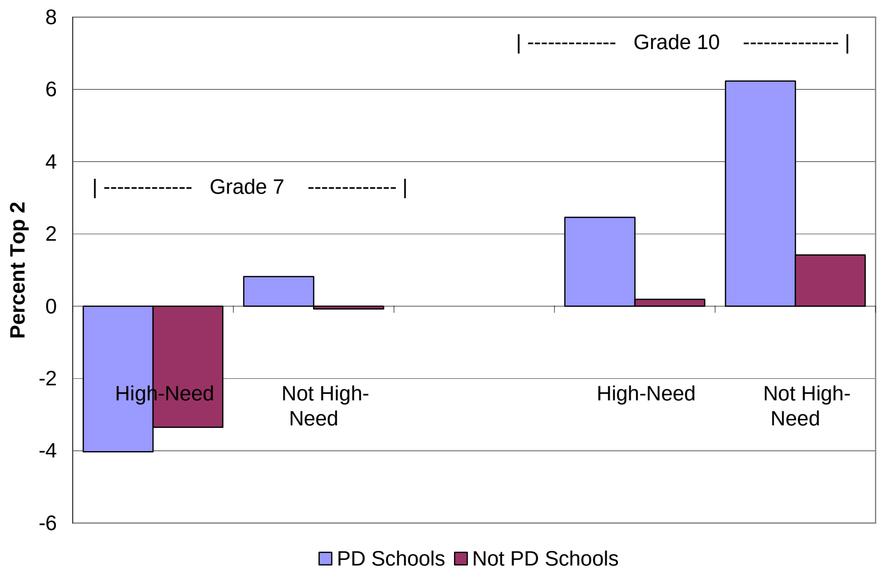
5. *What learning outcomes are demonstrated by students of participating teachers? Are those learning outcomes different than learning outcomes demonstrated by similar students in similar classrooms?*

Teachers in several projects administered pre and posttests to their students, usually in conjunction with delivering a unit of instruction designed as part of their PD experience. In the three cases where sufficient data were collected and reported by PIs, these classroom assessments showed that students performed better on posttests than they did on pretests. Because only two projects collected comparison data about student performance in non-PD classrooms, we cannot determine if the students in PD teachers' classrooms learned more than other students in their schools.

6. *Do aggregate measures of student achievement based on the Missouri Assessment Program (MAP) and/or other standardized assessments show increases in schools and classrooms of teachers who participate in PD activities?*

The preliminary results of the Spring 2006 administration of the MAP exams in science and mathematics were compiled to examine school level changes in performance in science at grades 7 and 10 and to examine school level performance on the recalibrated mathematics exams in grades 4 through 8. Descriptive analyses of school performance on the science exams suggested that schools which were not in high-need districts with teachers who participated in Cycle 3 PD projects performed better than non-PD schools. However, regression analyses that controlled for selected characteristics of each school's student population showed no significant relationship between PD participation and MAP performance. Descriptive analyses of school level performance on the MAP mathematics exams suggested that schools from high-need districts with teachers who participated in Cycle 3 PD projects performed better than non-PD schools at higher grade levels. This finding was supported by regression analyses. Note, that the analyses of performance on the mathematics exams does not speak to whether or not schools increased the scores of their students, only that the schools in PD projects tended to exhibit higher performance.

Change in School Level MAP Index Scores on the MAP Science Exam in 2006
Compared to Prior Average Performance



7. *How is science and mathematics education at partnership higher education institutions influenced by PD project activities?*

Five of the nine projects had PIs or staff members who responded to the *Higher Education Impact Survey*. Three projects reported the addition of one or more new science courses related to the PD project. Two of the new science courses were also cross-listed as education courses at one institution. Another project reported two separate new education courses. Three projects reported that science courses (totaling seven) had been changed because of the impact of the PD project. Typical changes included the addition or modification of labs to be more inquiry based. Regarding these new and changed courses, projects generally did not have substantive evaluation or effectiveness data, indicating that the changes were too recent. One project did report that the incorporation of inquiry based labs into a course corresponded with improved performance by students on a standardized chemistry exam. Projects reported that the sustainability of these changes would be predominantly through the support of the offering departments as well as the university; one project indicated the new courses were required for all elementary education students and that the university had committed to the new courses for at least three years. Other reported impacts of the projects included new or strengthened cross university collaborations (between education and science); and increased grant writing activity on campus.

Conclusions

The results from the external evaluation of the nine PD projects funded by Cycle 3 of Missouri's *Improving Teacher Quality* program provided insights that led to the following conclusions about the design and delivery of PD.

1. Elements of Effective Practice. The Cycle 3 RFP listed a set of core features of effective PD expected in funded projects. The funded PD projects in Cycle 3 demonstrated these core features to varying degrees. Certain core features were underrepresented, particularly those associated with developing meaningful school partnerships. Features tied to providing content and pedagogical knowledge were demonstrated across all projects.

2. Design/Delivery Features. In Cycle 3, two projects implemented a smorgasbord approach to PD where teachers could choose which sessions to attend. The value of such an approach lies in its underlying aim to meet teachers' varied logistical and content knowledge needs through a variety of offerings. However, both projects that implemented this approach found it difficult to create a shared vision for science/mathematics instruction or a sense of community among the participants in the project. Projects designed and delivered a variety of approaches to follow-up beyond the summer institute, that differed in quantity and quality. Teachers reported that they appreciated efforts to involve them in continued thinking about science and mathematics teaching after the summer institutes ended. They especially appreciated opportunities to share classroom implementation stories and strategies.

3. The Role of Mathematics in PD Projects. The Cycle 3 RFP requested projects that were aimed at "math and/or science content" (p. 2). Among the funded Cycle 3 PD projects, there was no project directed only at mathematics. Based on the small role of mathematics content or pedagogy in the majority of the Cycle 3 funded projects, the external evaluation has little to say about quality in mathematics education PD.

4. *Content Focus*. Each PD proposal identified specific mathematics and/or science content emphasis areas. In a few projects, the degree of alignment between teacher-reported and project-reported content emphases was strong, while in most projects this alignment was lacking. Perhaps some projects tried to do too much, resulting in content that was spread thin and emphasis areas that were not made explicit to participants.

5. Contributing to the External Evaluation. Two continuing issues with *Improving Teacher Quality* external evaluation include 1) the low response rate to evaluation instruments, especially in end-of-project settings; and 2) the lack of classroom-level control group data about student learning. Some projects in Cycle 3 managed to overcome these issues. It would be beneficial for other PIs to learn from those projects.

6. Partnerships with K-12. The Cycle 3 RFP required projects to represent partnerships between higher education and high-need K-12 schools. However fewer than 50% of participants taught in high-need districts. To accomplish needs-based PD design, partnerships must be in place during the design phase of the PD project and continued throughout project implementation. Many projects could benefit by closer relations with high-need school partners.

7. Shared Vision/Collaboration within PD Instructional Teams. The Cycle 3 RFP required that funded projects involve a partnership among various players—scientists and mathematicians, teacher educators, and K-12 colleagues. This partnership was realized in various ways in different projects. However, few projects included school-based personnel as key staff members. Partnerships among individuals from different backgrounds within an institution or from different institutions take time to develop. The individuals build understanding of and respect for their various areas of expertise after long hours of discussion and collaboration. In most cases, the more coherent the instructional team, the more effective the PD.

8. Projects Improve over Time. In addition to the time it takes to build a cohesive PD project team, it usually takes time to build high quality PD. When projects are funded repeated times or for multiple years, we have seen them improve in a number of ways. PIs used feedback from the external evaluation team and from their own participants to reflect on and revise their projects. In Cycle 3, we saw several instances of continuous quality improvement.

9. Balance within PD. According to Loucks-Horsley et al. (2003), effective PD must aim for two different kinds of balance: 1) a balance between theory and practice, and a balance between improving content knowledge and improving pedagogical knowledge and practice. Teachers and PIs often view these balance points differently. The most successful PD projects are ones in which PIs make their expectations for teacher learning clear, make their pedagogical models explicit, and integrate theory/practice as well as content/pedagogy.

10. Evaluator Role. We interpret our role to be program evaluators for the *Improving Teacher Quality* program, not internal evaluators for individual projects. However, in order to fulfill the program evaluator role, we are committed to collecting project-level data and providing feedback to individual projects to the extent possible. In Cycle 3 we expected that PIs would use the project-specific data we provided as part of their internal project evaluation and in their final project reports. This happened to a limited extent. We continue to discuss the best ways to provide *Improving Teacher Quality* program evaluation given the limitations we face as evaluators.

11. A Vision for Professional Development. The PD projects funded in Cycle 3 demonstrated many characteristics of effective PD discussed in the literature. They emphasized learning science/mathematics through inquiry, involved teachers in collegial learning, included a variety of PD activities that were coherent and long-term, and regarded teachers as members of a collegial and professional community. However, the *Improving Teacher Quality* program could be strengthened if PIs increase their emphasis on the following characteristics: inquiring into teaching and learning in lieu of transmitting information about teaching; regarding teachers as reflective practitioners who can produce knowledge about teaching and become leaders of other teachers, instead of as technicians, consumers, and followers; and thinking about teachers as sources and facilitators of change instead of targets of change. Such shifts in thinking about PD have the potential for improved outcomes for teachers and their students.

Learning to teach science and mathematics is a lifelong process. Professional development is a key strategy in helping teachers to learn new knowledge and practices so that their students can understand science and mathematics more deeply, enter science/math-related careers, and become informed citizens. This evaluation provides evidence that the *Improving Teacher Quality* objectives were met across all Cycle 3 funded projects, but not within each project. The PD projects displayed a number of innovative strategies for helping teachers learn and change their practice, as well as several areas where they could become more effective.

Recommendations

Based on the results and conclusions in this report as well as our experiences conducting Cycle 3 evaluation, we offer the following recommendations for future funding cycles of the *Improving Teacher Quality* program.

1. For PIs:

- Continue to build strong working relations among the PIs and instructional staff. Scientists, mathematicians and educators should capitalize on the expertise of each group to provide high quality PD for teachers.

- Continue to build a collaborative stance toward project evaluation. At the start of Cycle 3, PIs signed an agreement with the MDHE related to their commitments to project evaluation. In particular, PI contributions to external evaluation could improve in three areas: increasing response rates, assessing teacher content knowledge, and using data provided by external evaluators.

- Focus to a greater degree on assessment techniques that are aligned with content goals and inquiry methods, and expect teachers to use these techniques to gather data about their students' learning. We also recommend that teachers share results of assessments and review samples of student work as part of PD.

- Build stronger partnerships with K-12 school districts, beginning with the design of the PD project. This partnership might include K-12 personnel as Co-PIs or instructional staff on projects.

- Continue to find ways to pare down content to achieve a "less is more" approach. Find ways to balance theory and practice as well as content and pedagogy.

- Use the literature on best practice when designing and implementing PD. Shift emphasis to the following characteristics of PD: inquiring into teaching and learning in lieu of transmitting information about teaching; regarding teachers as reflective practitioners who can produce knowledge about teaching and become leaders of other teachers, instead of as technicians, consumers, and followers; and thinking about teachers as sources and facilitators of change instead of targets of change.

2. For Evaluators:

- Continue to explore ways to reduce the time and effort required of participants to complete evaluation instruments. In particular, reconsider instruments used to collect data about teacher knowledge and use of research-based pedagogy.

- Assist PIs in developing partnerships that include opportunities for school-level and comparison group data collection. Be proactive in working with participants and their schools about how evaluation efforts and findings might benefit them.

- Continue to work with PIs through all phases of the evaluation to help them understand the nature, purposes, and processes of evaluation and develop a collaborative spirit regarding evaluation. Continue to find ways to document projects which improve over several funding cycles within the constraints of a cycle-based annual evaluation report.

- Work with the MDHE to examine our roles and responsibilities as evaluators. To what extent should our time be spent on individual project evaluation (including formative feedback) and to what extent should our time be spent on analysis of all projects and evaluation of the *Improving Teacher Quality* grants program?

3. For the MDHE:

- Cycle 3 evaluation results informed us of benefits to projects that were funded multiple times. Thus, we recommend that the MDHE continue to fund projects over multiple funding cycles.

- The Cycle 3 RFP used some language which implied that PD is a one-way street with delivery and benefits flowing from university “providers” to teachers in schools. We encourage the MDHE to change from words like “provide” to partnership-friendly terms (e.g., build, collaborate, share).

- Facilitate the participation of high-need districts where multiple projects may be “competing” for participation by the same schools and districts. We recommend that the MDHE follow through on the expectation that the majority of PD participants are from high-need districts.

- Make a minimum requirement for total hours of PD (in summer institute and in follow ups) that PIs must document. Since time on task is an important factor in learning, there should be some expectations about the time participants should spend in PD activities, even when there is great freedom in how to structure that time.

- Provide guidelines to PIs for their final reports that include incorporating external evaluation data related to their specific project. We recommend that the MDHE encourage greater consistency in PI final reports including attention to external evaluation data.

- Help the external evaluation team examine our roles and responsibilities regarding *Improving Teacher Quality* program evaluation. In particular, we wonder how much responsibility we should assume for internal vs. external evaluation and how does the format of the evaluation final report align with those roles? We recommend that the MDHE provide guidance in this area.

- Support PI meetings where cross-fertilization of ideas (for recruitment, for working with school districts related to collecting control group data, for encouraging evaluation responses, for teaching summer institute sessions, for follow-up sessions, and for celebrating/presenting teachers’ classroom activities) can take place.

Reference

Loucks-Horsley, S., Love, N., Stiles, K. E., Mundry, S., Y Hewson, P. W. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin Press.

Copies of the full report and the Executive Summary are available at:
http://www.pdeval.missouri.edu/cycle_3.html

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