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Building a successful partnership between a university and local school districts.

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Abstract: This paper describes the use of the Collaborative/Cooperative Model of staff development as a means for providing content knowledge and pedagogical skills to middle school teachers. The study involved four sequential one-year projects to increase science (and related mathematics and literacy) content knowledge and skills. The research question addressed: What is the most effective staff development model to provide science (and related mathematics and literacy) content knowledge and skills to middle school teachers? The study involved an intensive two week workshop at the beginning with on-going electronic and formal university based follow-up activities. Using pre-and post testing, participating teachers were found to have significant gains in content knowledge and growth in implementation of content and skills.

Purpose

The purpose of this study was to study the effectiveness of the blended collaborative/cooperative staff development model (Joyce & Calhoun, 2010) as a means for providing targeted staff development to middle school science teachers (grades 4-8). The study took place on a master's granting university campus in New England and was funded by the state Teacher Quality Partnership grant project.

Background

A 2008 report from the Education Trust summarizes the research when it states, "Teachers cannot teach what they do not know. Research tells us that middle school … teachers with demonstrated knowledge of their subject areas produce stronger results with students, especially in mathematics and science. Yet through no fault of their own, many teachers are just a chapter ahead of their students in the courses they are asked to teach" (Ingersoll, pg.1). A key conclusion of the President's Council of Advisors on Science and Technology (Report to the President, 2010) was that "The most important factor in ensuring excellence is great STEM teachers, with both deep content knowledge in STEM subjects and mastery of the pedagogical skills required to teach these subjects well" (p. xi)

Thus, the conclusion that a teacher's knowledge of content is an essential characteristic of an effective teacher is axiomatic. Research continues to show us what experts have always recognized: requisite for effective teaching is that the teacher understands the ideas, purposes and structures of the subject matter to be taught. Teachers must have a depth and breadth of understanding of their content in order to adapt materials and activities to student needs and to provide the necessary support to assist students toward independent learning (Shulman, 1987, Harris, Mishra, & Koehler, 2009).

But this increasing emphasis on content is paired with an ever-changing expectation of the content to be taught. Newly developed content standards often ask teachers to teach students to a greater depth of knowledge than they themselves have gained in their undergraduate and professional preparation programs. Consequently, teachers must now engage in a sustained, intellectually rigorous study of what they teach and how they teach it. College/university faculty who prepare teachers must model strategies those teachers will be asked to use (Sparks, 1998). Demanding content standards require high-quality staff development that helps practicing educators reach this depth of understanding (Hirsh, 2003).

While there are many models for successful staff development, one of the most widely recognized is the Collaborative/Cooperative Model (Joyce & Calhoun, 2010). This model is based on the belief that "teachers who think and study together can make positive changes that, moreover, can make a serious difference in student learning in a relatively short time." (p.62). This model purports to "organize groups… to learn from one another's' repertoires…and guild their stock of professional tools" (p.63) and is based on three premises: collective action increases positive, learning of selected knowledge and skill, and implementation of this learned knowledge and skills.

In 2003, we formed our first collaborative effort to improve teacher science content knowledge and pedagogical practice with a proposal for a Connecticut Department of Higher Education (CDHE) Teacher Quality Project (TQP) grant. Since then we have had four more one-year grants and are in the second year extension of our fifth grant.

Our early partnering districts had many needs. They generally struggled with one of the worst achievement gaps in the country and significantly changing curricular guidelines from the state. They were anticipating state-wide testing in elementary science in 2007-2008. Most schools and districts in eastern Connecticut have elementary teachers with little preparation to teach science and it was obvious that Reading and Mathematics, where district resources had to be focused, were going to be long-term improvement projects.

In collaboration with our early partners, we offered the opportunity for elementary/middle school teachers at varying grade levels to increase their science content knowledge. A true collaborative effort treats all parties as equals and successful professional learning opportunities reflect the desires of the participants. Since (1) CDHE's early grant parameters required professional development that focused on content, since (2) both feedback from districts and teachers asked for help with strategies to teach the content (pedagogical content knowledge –PCK), and since (3) the project developers had collectively many years of experience in both K12 teaching and professional development as well as a strong commitment to constructivist learning theory (Beamer, Sickle, Harrison, & Temple, 2008), the project developers built a collaborative/cooperative model (Joyce & Calhoun, 2010) based on a two week intensive workshop addressing content through expert direct instruction, hands-on (inquiry based) modeling and instruction, and peer networking (Boyle, Lamprianou, & Boyle, 2005; Harry & Mechling, 2010; Robertson, 2010).

Based on the research of Loucks-Horsley and others, the early years of our design began with content delivered through workshop/seminar format with strong hands-on, content pedagogical modeling. Over the next five years, it evolved to include professional networking and online resources. We recognize that the most effective staff development (ERS, 1998; Hassel, 1999; Clair & Adger, 1999; Loucks-Horsley, Stiles, Munday, Love & Hewson, 2010) occurs when: (1) teachers have an integral part in the planning; (2) teachers dictate the content they need; (3) teachers see an imminent need for the content; and (4) the training is conveniently scheduled. We believe that effective instruction requires teachers to present, explain, model and discuss content (Brophy, 1999) but more importantly to engage students in learning (Vosniadou, 2001).

Over the years, based on teacher feedback and district input, our professional learning model was refined by both the project developers (from Education faculty) and the content area faculty (from science departments within the School of Arts and Sciences). We increased emphasis on application, pedagogical modeling and resources, and on-going support. This on-going support was frequently technologically facilitated.

Design

The design was the same for each of the four one-year studies. There was an introductory workshop with follow-up activities during the academic year. Follow-up activities involved both formal after-school sessions at the university and informal contact with education and content faculty through phones calls, school visits and on-going access to electronic resources. Each workshop lasted 7-10 days at the end of June ending before July 4. Each morning Arts and Sciences faculty presented content based on the teacher identified science standards. During lunch, research by faculty was presented. Afternoons were devoted to morning content delivered through hands-on pedagogical models taught by Education and Arts and Sciences faculty. Each district received a set of materials used during the workshop for district replication. Although there were variations in follow-up content and strategies over the four projects, the use of threaded discussions and electronic access to university faculty spanned all studies as did semester follow-up sessions at the university. These sessions were based on two things: 1) A portion of each session included sharing the challenges and successes of each participant in implementing learned content; and 2) Content or pedagogical strategies specifically identified by participants for further study. After the first year additional follow-up day(s) were scheduled at the end of each grant project for closure.

Analysis

Each year between twenty five and thirty participants were given a pre and a post-workshop assessment based on the identified science content. Both pedagogical and content faculty collaborated to select content based on the appropriate grade level standards identified by participating teaches and districts. Each year the pre-test was administered the first morning and the post-test given the last afternoon. The teachers' responses to these tests were graded by the content experts in the same way they would grade the content knowledge of their college students enrolled in their academic major. The same experts graded both the pre- and post-tests to ensure consistency. As shown below, each year the analysis indicated that the difference between the pre- and the post-test means in participating teachers' science content knowledge was statistically significant (see Table 1).

Table 1. *t*-test for Pre- and Post-test Science Scores for Teacher Quality Partnership Projects

Year	N	*M*	*SD*	*t*-test	*p*	Significance
2004: 5^{th} & 6^{th} grade teachers	19	76.45 (56.09*)	20.67 (20.08*)	6.2585	0.0000069	$p<.001$
2005: 7^{th} & 8^{th} grade teachers	23	83.2 (64.1*)	20.2 (30.5*)	3.74	0.000566	$p<.01$
2006: $6^{th,}$ 7^{th}, & 8th grade teachers	19	72.7 (63.09*)	20.17(26.95*)	1.7689	0.04699	$p<.05$
2007: grade 4-8 teachers	25	78.0 (63.0*)	25.3 (33.9*)	1.8371	0.0393	$p<.05$
2009: grade 3-6 teachers	27	4.06 (3.55*)	NA	5.3645	0.0000	$p<.001$

*Pre-test Means and Standard Deviations are within parentheses.

It appears that our participants had a greater content gains during 2004 and 2009. The focus on nonfiction children's books as a means to teach science, particularly in 2009, may have had the unintended effect of helping the teachers build more content knowledge during the pedagogical time in the afternoons. There was no apparent difference in the science training of the teachers prior to the 2009 workshop. Based on the overall results, it was found that the collaborative/cooperative model of staff development is a successful method to increase science (and related mathematics and literacy) content knowledge and skills.

Implications

The success of this model over a series of four consecutive projects demonstrates its viability for improving teacher content knowledge and building learning communities.

Following the first year, teachers provided much of the incentive for additional efforts. They asked for additional opportunities, suggested additional content and pedagogical needs, advocated with district level personnel, and recruited their peers.

Limitations

Consistently over the years, our cooperative/collaborative model with its conceptual focus on content knowledge gained through direct and constructivist models (Harry & Mechling, 2010) of teaching demonstrated through pre-and post- test analysis that teachers' gain in science content knowledge was statistically significant at the .05 to .01 level of significance. Anecdotally, in focus interviews and informal discussions with us, teachers told us that they implemented strategies with consistent student success. Districts continued to partner with the project indicating that they were pleased with the direction their teachers were moving. Unfortunately with a series of single year projects with differing grade levels, varying participating districts, and revolving teacher participants, no opportunity existed to truly measure either fidelity of implementation or the impact of this professional development on student learning.

Future Research

Based on results of these grants several additional areas of research are apparent. There is a need for longitudinal research as to the retention of content as well as application of the pedagogical strategies introduced. Impact on student learning also needs further study.

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