Abstract

Nationally, there is a growing shortage of science teachers (NCMSTTC, 2000; National Research Council, 2007). As a result, many school districts are forced to hire teachers with science degrees but little or no training in education. These ill-prepared, new science teachers face the extra challenge of discovering how to teach on their own. Goals of the New Science Teachers’ Support Network (NSTSN) are to help uncertified science teachers succeed at teaching and to remain in the profession. In a community of practice, NSTSN provides an integrated support system for first and second year science teachers in secondary schools and conducts research to determine what makes the most significant difference in teaching. Working with middle and high school science teachers in this six-year study, NSTSN chronicled the experiences of 59 uncertified teachers in 35 schools in three large, urban-suburban school districts and the people supporting them to determine how new teachers’ needs were addressed and consequences of those actions.

Research findings from NSTSN reveal that students enrolled in classes of teachers who received support performed significantly better on state-wide standardized science tests than students enrolled in classes of a comparable set of new science teachers who did not receive support ($M_T = 37.50$, $SD_T = 8.26$, $M_C = 35.80$, $SD_C = 8.53$, $t(5837) = 7.61$, $p = .001$). Additional data indicate that teachers receiving supports of NSTSN experience significant growth in their instructional skills. Findings from NSTSN also identify a series of challenges teachers face when new to teaching and how to mitigate them through a community of practice with a focus on continuous improvement. Research identifies the most vital forms of support for new science teachers as supportive working conditions, supportive school culture, in-classroom support, and quality courses in how to teach science. These findings led to a series of policy recommendations for school leaders.

Challenge

Nationally, there is a growing shortage of science teachers (NCMSTTC, 2000; National Research Council, 2007). As a result, many school districts are forced to hire teachers with science degrees but little or no training in education. Research indicates a link among teacher preparation, teacher classroom performance, and student achievement. The Report by the
National Commission on Mathematics and Science Teaching for the 21st Century (NCMSTTC, 2000) reported that more than 12% of new hires begin teaching without any formal pedagogical training; 26% of new hires do not meet the requirements for certification in their state. These ill-prepared, new science teachers face the extra challenge of discovering how to teach on their own. Research shows that 66 percent of these new teachers will quit the profession within three years (Darling-Hammond, 2000, 2003) creating a revolving door of unqualified teachers rotating through our schools (Ingersoll, 2000; Ingersoll & Perda, 2009; Marvel, et al, 2006).

Impact of Teacher Training on Student Achievement
There are high costs associated with continually hiring, training, and losing new teachers, not only in dollars but also in staff morale and student achievement. Well-prepared teachers have the largest positive impact on high student achievement (Darling-Hammond, 2000, 2003). Teacher preparation and on-going development play a strong role in students’ science performance. The Educational Testing Service found in its study, How Teaching Matters (Wenglinsky, 2000), that student achievement increases when teachers are skilled at teaching. For new science teachers to have the potential to produce high-achieving science students, they need to know their science content and also be skilled in how to effectively plan, teach, assess, and motivate students for learning. Based on these findings, the New Science Teachers’ Support Network (NSTSN) targets new uncertified science teachers who possess adequate content knowledge, but need training in proven teaching practices. Though the purpose of schools is to help students learn, in some cases the best way to help students is to help teachers.

Teacher Self-Efficacy
Research has also shown that as new teachers embark on a career in teaching, they often possess high self-efficacy, but their self-efficacy declines as they encounter the challenges of teaching, resulting in feelings of dissatisfaction and disillusionment (Moir, 1990; Rosenholtz, 1989). Teacher self-efficacy is defined as judgments of one’s capability to improve student engagement and learning in the classroom (Tschannen-Moran & Woolfolk Hoy, 2001). Self-efficacy is an important construct to examine, because research indicates that teachers reporting high self-efficacy are more likely to teach their students more effectively, and foster fruitful relationships with these students (Guskey, 1988; Bandura, 1997). In contrast, teachers with low self-efficacy are more likely to detest teaching and consequently be less effective teachers and less nurturing to their students (Melby, 1995).

Previous research has shown that teachers’ performance, commitment, and persistence to a task despite occasional failures has consistently correlated with teachers’ self-efficacy, a measure of motivation (Guskey, 1988; Tschannen-Moran, & Woolfolk Hoy, 2001). For teachers, self-efficacy is a strong predictor of teacher retention (Darling-Hammond, 2003). Given that an individual’s quality of performance and commitment to work has been linked to one’s motivation level (Bandura, 1997), a goal of the NSTSN for uncertified science teachers is to increase their self-confidence as science teachers. Numerous studies have examined (a) the factors that impact teachers’ efficacy beliefs and (b) how novice teachers’ self-efficacy beliefs about effective teaching fluctuate throughout the first year of teaching (Chester & Beaudin, 1996; Tschannen-Moran & Woolfolk Hoy, 2001). However, no studies have investigated the impact of intensive, comprehensive interventions, such as that provided by the NSTSN (e.g. mentoring and coaching integrated with coursework in how to teach), on teachers’ self-efficacy. With the growing teacher shortage and, therefore, lack of fully prepared teachers that school
districts are able to hire, there is a need for research that targets new uncertified science teachers, who possess bachelor’s degrees in science, but need training in proven teaching practices.

Theoretical Perspective

This professional development program is grounded in the theoretical framework of a community of practice (CoP) for continuous improvement of new teachers as they craft their teaching practice. Continuous improvement assumes that with collaborative planning, thoughtful reflection, and data collection and analysis that teachers can become more effective at helping their students learn science.

In 2002 when the current research study was planned, there was little research about induction programs and most programs involved only assigning a mentor to a new teacher. Though this seemed to be helpful, it did not appear to be sufficient. Therefore, the current study was guided by the research question: What support for uncertified science teachers made a difference in teaching and learning and how did it make a difference? The study integrated multiple support systems and assessment measures, within a framework of continuous improvement of learning as part of creating a community of practice. Based on the research that suggests a more integrated approach to induction programs, the NSTSN established a culture of support for new, uncertified science teachers.

Community of Practice

Communities of practice are based on a social theory of learning where the learner is an active participant in the social community (Wenger, 1998). Engaging in a community of practice is important for fostering personal growth (van Driel, Beijaard, & Verloop, 2001; Wenger, 1998) as opposed to struggling on your own. Learners develop individual identities based on their experiences in the community. Identity development requires reflection on their practice, acknowledging how they have changed their practice, and understanding their roles in the community (Wenger, 1998). Collaborative reflection empowers teachers to “examine their beliefs and make changes in their practice” (Keys & Bryan, 2001, p. 636). In their CoP, teachers become aware of the changes in their views about teaching as they struggled with teaching and discussed their struggles with the member of in their community (Akerson, Cullen, & Hanson, 2009).

A CoP draws on situated learning theory which involves a community of participants with a wide range of expertise who work collaboratively for the benefit of all (Lave, 1988; Lave & Wenger, 1990). According to Anderson and Helms (2001), “Teachers working together in collaboration towards similar goals represent the most effective path to change (p. 9).” A CoP for teaching also is supported by social cognitive theory that stresses effective professional development, addresses social needs, and develops self-motivated and self-regulated teachers (Bandura, 1997; Zimmerman, 2000). As new practices are developed, they need to be shared.

Communities of practice support the conceptual change process, whether it is new information or confronting misconceptions. Research suggests that in order for conceptual change to take place deep restructuring in ways of reasoning is crucial with new associations and knowledge connected with existing structures and knowledge (Furio, Catatayud, Barcenus, & Padilla, 2000;
Hewson & Hewson, 1983; She & Liao, 2010). To create new reasoning patterns an individual responds to inadequacy using present reasoning patterns (Karplus, 2003). According to Karplus, during exploration learners gain experience with new situations, during concept introduction learners socially exchange and define new information, and during concept application learners apply the new concept or reasoning pattern to a new situation. Conceptual change for misconceptions is based on Piaget’s (1964) work of construct disequilibrium where people become dissatisfied with their current conception. This dissatisfaction is a cause for disequilibrium. Disequilibrium exists until the person strikes a balance between assimilation and accommodation. A CoP can provide a venue for discussing classroom situations and practices that don’t seem to be working as efficiently as the CoP would like.

Through long term commitment, a variety of needs and instructional improvement can be addressed by multiple kinds of support over an extended time period. Professional development that takes place over an extended period of time is more successful at producing intended change (Supovitz & Turner, 2000, van Driel, Beijaard, & Verloop, 2001, Yoon, Duncan, Lee, Scarloss, Shapley, 2007). The extended time allows for collaboration to take place and action research to be conducted (van Driel, Beijaard, & Verloop, 2001).

Teachers are immersed in educational situations where they help students to make meaning and where they make meaning for themselves (Feldman, 2002). For those of us who are teacher educators, we need to find ways that enable teachers to change by working within the constraints of their situation and to see possibilities of what it will take to become even more effective at enabling student learning. Coaching is a process where the coach and the teacher exchange ideas, implement these ideas and reflect on their outcomes (van Driel, Beijaard, & Verloop, 2001). This takes time and on-going exploration.

Otto, Luera, and Everett (2009) found missing in typical teacher preparation programs the introduction to educational research to improve teaching practice. Both the National Science Education Standards and the National Science Teachers Association (1990) call for teachers to be engaged in using and conducting research. The NSES Professional Development Standard C states that “professional development activities must provide opportunities to learn and use the skills of research to generate new knowledge about science and the teaching and learning of science” (NRC, 1996, p. 68). Common features of CoP and collaborative action research are ownership of specific problems they want to collaboratively explore, the research they conduct, the data they collect, and the actions they take (van Driel, Beijaard, & Verloop, 2001). Best practices research on effective teaching and professional development programs indicates the importance of a collective sense of commitment and responsibility for serving children (Guskey, 1995; Ruskus, Luczak, & SRI International, 1995; Sterling, 1997, 1999, 2000; USDOE, 1999).

The NSTSN established instructional support for new, uncertified science teachers to help them develop their teaching identity based on (1) standards-based learning (AAAS, 1993; Kahle, Meece, & Scantlebury, 2000; NRC, 1996; VDOE, 2003), (2) teaching for understanding (Hiebert, et. al., 1997; Sterling, 2001; Wiggins & McTighe, 1998), and (3) collaborative action research as a method of investigating student conceptual understanding (Bandura, 1977; Cross, 1981; Fullan, 1991; Gallagher, 1996; NCMSTTC, 2000; Newmann & Wehlege, 1995; Rogers,
Continuous Improvement

Zmuda, Kuklis, and Kline (2004) define continuous improvement as “an unwavering commitment to progress” (p. 17). The education community has adopted the theories of W. Edward Deming (1986) for improving the quality of product production (student performance). Through a continuous improvement model of quality management, products and services were greatly improved through more effective product management and testing. Though his work was originally conceptualized for the business community, it applies equally to school districts, schools, and classrooms. “Every job is part of a process … At every stage there will be … continual improvement of methods and procedures” (Deming, 1986, p. 87).

Schmoker (1996) advocates that the key to continuous school improvement is “meaningful teamwork; clear, measurable goals; and the regular collection and analysis of performance data” (p. 2). The importance of teamwork for productive change is echoed by business leaders Tom Peters (1987) and W. Edward Deming (1986). According to Schmoker (1987), “teamwork is perhaps the most effective form of staff development” (p. 12). In contrast Zmuda, Kuklis, and Kline (2004) describe “for staff development to be effective, it must be an integral part of a deliberately developed continuous improvement effort” (p. 5). This is also inline with collaboration in communities of practice (Akerson, Cullen, & Hanson, 2009; Keys & Bryan, 2001; Wenger, 1998). Schmoker’s (1986) research indicates that teamwork and goals are both essential to performance, each depending on the other to build cohesion.

Change is difficult and collaborative support of communities of practice can assist teachers with ideas and feedback through the change process (Marzano, 2003; Marzano, Pickering, & Pollock, 2001). Reeves (2009) states that sustainable change depends “upon the pursuit for the greater good” (p. 125).

Purpose and Hypotheses

The purpose of this quasi-experimental study was to assess the impact of various support factors on the success and retention of uncertified science teachers at the middle and high school levels. These teachers have a science degree, but little or no training or experience in teaching. As a result, they struggle in the classroom and are unprepared to meet the demands that are required of them as new teachers. The New Science Teachers’ Support Network (NSTSN) was established to provide support through a CoP to these teachers during their first two years of teaching so that they would excel as teachers and remain in the profession. It was hypothesized that uncertified science teachers exposed to the various forms of support provided by the NSTSN would show higher efficacy beliefs and have higher student grades and state test scores than a control group of teachers not exposed to the supplemental support system of the NSTSN. It was also expected that treatment teachers would show significant improvement in their instructional skills and overall performance as compared to their control counterparts.
Program Description

Goals of the New Science Teachers’ Support Network (NSTSN) were to help uncertified science teachers succeed at teaching and remain in the profession. NSTSN provides an integrated support system for first and second year science teachers in secondary schools and conducts research to determine what made the most significant difference in teaching. A culture of support for new, uncertified science teachers was established through six forms of support (see Table 1). The community of practice (CoP) for the new teachers was mainly fostered through course instructors, classroom coaches, and mentors. The focus was on continuous improvement, because it was felt that new teachers with little or no teacher training would be able to learn and improve their teaching skills with the support and sharing of knowledge by experts in different facets of teaching. This led to overlapping communities of practice, all sharing the same overarching goal, to help new teachers succeed at teaching (see Figure 1). The smaller communities were a new teacher, instructor, coach, and mentors. A larger community consisted of the coaches and instructors who met and worked together to determine and share what helps new teachers. Yet another community included the new teachers and course instructors who collaborated together during science methods courses.

Table 1

<table>
<thead>
<tr>
<th>Support</th>
<th>Who received</th>
<th>Year</th>
<th>Description</th>
<th>Overlap/scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Science Methods Course</td>
<td>Treatment</td>
<td>1</td>
<td>3 graduate credit course</td>
<td>Initial form of support if teacher hired before the school year starts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Built fundamental knowledge of standards-based curriculum design and research-based teaching strategies</td>
<td>Full week before school began with 7 follow-up fall sessions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Developed inquiry-based lessons</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Developed classroom assessment tools</td>
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<td></td>
<td></td>
<td></td>
<td>Observed videotapes of themselves teaching and students’ learning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Analyzed samples of their students’ work</td>
<td></td>
</tr>
<tr>
<td>Coach</td>
<td>Treatment</td>
<td>1 and 2</td>
<td>Recently retired science teachers</td>
<td>Participated in basics methods course</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Provided support in the classroom while teaching was taking place</td>
<td>Assigned within a week of teacher joining program</td>
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<td></td>
<td></td>
<td></td>
<td>Assisted with short and long term planning</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Supported teachers in any</td>
<td></td>
</tr>
<tr>
<td>Role</td>
<td>Treatment</td>
<td>Course 1 and 2</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Academic Mentor</strong></td>
<td>Treatment</td>
<td>1 and 2 University science faculty Available throughout the year for questions about science content Presented New Frontiers Seminars in courses</td>
<td>Participated in basics and advanced methods courses</td>
<td></td>
</tr>
<tr>
<td><strong>Teaching Mentor</strong></td>
<td>Treatment and control</td>
<td>1 Classroom teacher in the same school as new teacher Provide information on the school's protocols Providing teaching ideas Find resources for teaching</td>
<td>Required by state Assigned by school</td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Science Methods Course</strong></td>
<td>Treatment</td>
<td>2 3 graduate credit course Learned to use technology for students to investigate science Adapted inquiry-based lessons to the special needs of students Conducted collaborative action research</td>
<td>Builds on basic methods course</td>
<td></td>
</tr>
<tr>
<td><strong>Website</strong></td>
<td>Treatment and control</td>
<td>1 and 2 on-going Website Recruit teachers for support program Support teachers in the second methods course with technology and special needs resources (Treatment only)</td>
<td>Combination of general access and password-protected access Used in advanced methods course</td>
<td></td>
</tr>
</tbody>
</table>
The first form of support available to uncertified teachers in the treatment group was a basic science methods course, EDCI 573: Teaching Science in the Secondary School, which started with a full week of planning before school began and then had seven follow-up sessions during the fall semester for two hours each where the teachers analyzed samples of their students’ work. The course was crafted with the particular needs of uncertified teachers in mind. The course built fundamental knowledge of science teaching and learning including standards-based curriculum design and research-based teaching strategies. The course focused on developing inquiry-based lessons for students to investigate science and assessing student understanding of science. During the summer the teachers learned about classroom management strategies, created an annual instructional plan that charted when they would cover each major topic in the curriculum over the academic year, taught an inquiry-based lesson they would teach the first week of school, and planned a ready-to-teach four-week unit with all support materials that clearly and directly related to the state science standards and the National Science Education Standards (NRC, 1996). During the fall semester, the teachers observed videotapes of themselves teaching and students’ learning. Further, they conducted research on student learning. Coaches, who were retired science teachers from the participating school districts, and academic mentors, who were science content faculty from the university, participated in the methods course. Reflective practice was a fundamental precept of the first science methods course. As the teachers began their teaching, they rejoined their classmates every two weeks to reflect on their

Figure 1. Overlapping communities of practice

Basic Science Methods Course

T=teacher, I=instructor, C=coach, M=mentors, +=others
experiences in the real world of the middle and high school classroom. The ideas proposed in the summer week of coursework were refined and revisited in the light of their own students and experiences teaching. During the fall semester, the teachers shared samples of student work from their classes (from the top, middle, and bottom third levels of student performance). They discussed what SOL concepts were targeted, what the students understood about the concept, and what the students did not understand about the concept. As a final product, teachers produced a portfolio that specifically focused on student learning.

Coaches
The second element of support for uncertified teachers in the treatment group was a cadre of coaches, who provided in-classroom support for all participants in the treatment group. These coaches were retired master science teachers, recommended by science specialists in the school districts. The term “coach” was selected in order to avoid confusion between the support personnel provided by the NSTSN and the state-mandated “mentor” appointed by the schools. Coaches were assigned to the teachers within the first week that the teachers entered the program. These coaches provided hands-on support while in the classroom with the uncertified, “provisionally-licensed” teacher. They co-planned and sometimes co-taught lessons. The coaches met with the teachers for 96 hours (at least 12 visits) during the first academic year, with more visits at the beginning of the year than the end. During the second academic year, coaches continued to visit their teachers for a total of 24 hours (at least 3 visits) with one visit at the beginning, middle, and end of year. Coaches provided help and consultation for many situations the new teachers faced. Some areas in which coaches provided advice and other assistance included developing classroom and laboratory management strategies, planning short-term and long-term organization of standards-based course content, assessing student progress and achievement, and finding and creating teaching materials. Those who were selected met with the researchers in summer, early fall, winter, and late spring for sharing of experiences, feedback, and training each year they were in the program. Coaches received a stipend to support the new teachers and fill-out data collection instruments after each site visit based on their observations and work with the teachers.

Academic Mentors
The third form of support was an academic mentor who was a university science faculty member. The faculty members were selected because they related well to future teachers and their area of science specialty (Earth science, biology, chemistry, or physics) was the same as their assigned teacher. Academic mentors met the uncertified middle and high school science teachers in the treatment group during the summer week of classes and were available throughout the year to the new teachers for questions about the science content through email, via telephone, or face-to-face meetings. They also each presented a "New Frontiers Seminar" during the academic year when they shared cutting edge research in their field during one of the class session for the courses.

Teaching Mentors
The fourth form of support was a teaching mentor provided for all first-year teachers, meeting a state requirement. As a result, teachers in both the treatment and control groups had a teaching mentor. Teaching mentors were full-time classroom teachers who taught in the same school as the first year teacher. They were assigned by the individual schools. Depending on their teaching schedules, mentors and novice teachers met before or after school, during planning periods, or
for “between class” conversations. The state and school divisions had no guidelines regarding the selection and training of mentors or the frequency, duration, or content of mentor/mentee interactions. Once identified by the schools, mentors assigned to teachers in the treatment group were invited to collaborate within the NSTSN. In our program, mentors received a stipend to fill-out data collection instruments about the new teachers.

**Advanced Science Methods Course**

The fifth element of support for uncertified teachers in the treatment group was the second science methods course, EDCI 673: Advanced Methods of Teaching Science in Secondary Schools, which met once a week during the spring semester. The course built on the fundamentals of curriculum design and teaching from the first science methods course. The course focused on (1) using technology for students to investigate science and (2) adapting inquiry-based lessons to the special needs of students. In terms of technology, the course was designed to help uncertified science teachers build a repertoire of teaching and assessment strategies using technology to help students become scientifically literate and see relationships among science, technology, and society; demonstrate the use of technology in teaching science; and develop inquiry-based lessons for students to use technology to conduct science experiments, to research science issues, to analyze data, and to communicate findings. Utilizing the partnership of the NSTSN, exemplary inservice teachers in biology, chemistry, Earth science, and physics were selected to instruct, monitor, and support the new teachers throughout their learning. Approximately half of the class meetings were held in a public high school so that the teachers could learn in an authentic setting to improve transferability of their learning to their own classrooms. Working in content-area teams in the exemplary teacher’s classroom, each team of teachers used technology that scientists use and created technology-based activities to help students learn science under the supervision and support of an exemplary teacher of the same content area. To further their knowledge and use of technology in teaching, they chose one technology they had not used before and set it up to use with their students. Technology included probeware, simulations, SMART Board technology, and course management software. In addition, the teachers created a web-based inquiry activity for their students to use to learn science, and they wrote a proposal to purchase technology for use in their classroom.

To assist uncertified teachers in their growth as educators capable of meeting the needs a diverse student population, teachers were guided and supported by experienced science teacher education faculty as they critiqued, adapted, and constructed standards-based lessons that include assessment and hands-on experiences for the diverse needs of learners with respect to gender equity; cultural diversity; the needs of English language learners; achievement levels; and the physically-, socially-, and emotionally-challenged. The teachers worked collaboratively with their peers to adapt instruction and conduct collaborative action research on student learning in order to meet the special needs of students and to extend or improve their students' understanding of science. During the process they learned about online resources that are available to assist them in their efforts toward meeting the needs of students with different needs and challenges.

**Website**

The sixth form of support, the NSTSN website, was created for recruiting teachers, data collection, and to support the treatment teachers in the second methods course. The NSTSN website is part of the CREST website housed on a GMU server. This website provides descriptive information about the NSTSN and recruiting information. The website also includes
teacher resources that consist of links to teaching strategies to meet the special needs of students and information on technology resources for science teaching. There is also a password-protected Blackboard website to support the students in the second science methods course. Another password-protected portion of the website was utilized for data collection through online surveys.

Methodology

Participants
In this six-year study, NSTSN chronicled the experiences of 59 uncertified middle and high school science teachers in 35 schools in three large, urban-suburban school districts to determine how new teachers’ needs were addressed and consequences of those actions. Each participating teacher was uncertified with a bachelor’s degree in science and limited teaching experience. Teacher participants (female, N=32; male, N=27) ranged in age from 23 to 66 years, with a mean age of 34.7 years. There were 49 Caucasians, 4 African Americans, 4 Asian Americans, and 2 of mixed ethnicity. Upon entry into the program, teachers were randomly assigned to treatment (N=35) and control groups (N=24) and committed to participating for two years. Both control group and treatment group teachers were provided with a school-assigned teaching mentor for one year as required by the state. The mentor was normally a fellow teacher in the new teacher’s school and frequently did not teach the same courses as the new teacher. In addition, treatment group teachers received extended in-class coaching support from retired science teachers usually with experience teaching the same science content area, methodological science courses, academic mentors who were science content faculty from the participating university, and website resources over a two-year period. The control group did not receive these supplemental support services.

Research Design
This quasi-experimental study collected qualitative and quantitative data concurrently from teachers, students, mentors, and coaches through site visits, online surveys, and student outcome assessments. Retired science teachers conducted site visits as instructional coaches every two to three weeks throughout the teacher’s first year and at the beginning, middle, and end of the second year. More than 400 site visit reports were made covering over 3,000 hours of observation. Online surveys were conducted at the beginning, middle, and end of the first and second years. Student assessment data were collected from the school districts at the end of each year on more than 10,000 students of teachers in the study.

Quantitative data were analyzed using SPSS and Microsoft Excel. Qualitative data were analyzed using NVivo to assist with the constant comparative process of grounded theory (Glaser, 1978; Glaser & Strauss, 1967; Strauss & Corbin, 1998) and cross-case synthesis (Yin, 2003). As responses were examined, they were coded, tallied, ranked, and analyzed for emergent themes (Creswell, 2008). Emergent themes were further analyzed using Microsoft Excel spreadsheets to graphically analyze data for patterns in change over time.

Findings and Discussion

Impact on Students
Research findings from NSTSN reveal that students enrolled in classes of teachers who received support performed significantly better on state-wide standardized science tests than students enrolled in classes of a comparable set of new science teachers who did not receive support ($M_T = 37.50$, $SD_T = 8.26$, $M_C = 35.80$, $SD_C = 8.53$, $t(5837) = 7.61$, $p = .001$). Logistic regression analysis revealed a significant difference ($p = .008$) between pass rates of treatment and control teachers’ students. Controlling for course grade point average, socio-economic status, gender, ethnicity, disability-status, and English language learner status, treatment teachers’ students were 1.225 times more likely to pass state-wide standardized science tests than control teachers’ students. Additionally, more treatment teachers’ students earned significantly better course grades than students of control teachers ($N_T=5,629$ vs. $N_C=4,193$). These findings show that teachers who received professional development support in a community of practice that focus on continuous improvement were more likely to do a better job teaching and hence their students’ achieved greater learning as indicated by standardized test scores. This result is substantial because the students of teachers who received support performed better on end-of-year standardized tests for the teachers’ first two years. Clearly, well-prepared teachers have the largest positive impact on high student achievement (Darling-Hammond, 2000, 2003). The overall positive impact on student performance reported here is consistent with Sterling & Frazier (2008) who examined the impact of support on novice science educators and found that a synchronized combination of in-classroom support from experienced teachers, support in how to effectively teach from methods instructors, and peer support resulted in students’ positive content knowledge growth. It also echoes findings from Educational Testing Service’s study, How Teaching Matters (Wenglinsky, 2000), on the impact of teacher preparation and continuing development. The study found that student achievement increases by over 40 percent of a grade level when teachers are skilled at implementing hands-on experiences in the classroom, by over 40 percent of a grade level when students have teachers who are trained in laboratory skills, and by 92 percent when teachers utilized research-based assessment practices.

Impact on Teachers
Quantitative data indicated that teachers receiving support from NSTSN experienced significant growth in their instructional skills, specifically in the areas of personal content knowledge, ability to impact student learning, ability to meet the needs of diverse learners, ability to deliver quality instruction, ability to provide a positive learning environment, ability to effectively communicate with students, ability to plan for inquiry-based instruction, ability to implement research-based assessment practices, their demonstrated reflective professionalism, ability to form partnerships within and outside the school, their classroom management practices, and ability to provision for instruction (see Tables 2, 3, 4, and 5).

Table 2
Coach ratings over two years by Interstate New Teacher Assessment and Support Consortium (INTASC) standard

<table>
<thead>
<tr>
<th>INTASC Standard</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
<th>Pre/Mid</th>
<th>Mid/Post</th>
<th>Pre/Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Content</td>
<td>M 1.26</td>
<td>M 1.97</td>
<td>M 2.32</td>
<td>$t(30) = -8.93$, $p = .000$</td>
<td>$t(24) = -5.55$, $p = .000$</td>
<td>$t(24) = -8.98$, $p = .000$</td>
</tr>
<tr>
<td>2 Student Learning</td>
<td>M 1.09</td>
<td>M 1.79</td>
<td>M 2.17</td>
<td>$t(30) = -6.71$, $p = .000$</td>
<td>$t(24) = -4.77$, $p = .000$</td>
<td>$t(24) = 8.63$, $p = .000$</td>
</tr>
<tr>
<td>3 Diversity</td>
<td>M 1.06</td>
<td>M 1.90</td>
<td>M 2.4</td>
<td>$t(30) = -6.00$, $p = .000$</td>
<td>$t(24) = -4.10$, $p = .000$</td>
<td>$t(24) = -7.19$, $p = .000$</td>
</tr>
</tbody>
</table>
### Table 3

Coach ratings over two years by Interstate New Teacher Assessment and Support Consortium (INTASC) standard -- repeated measures with repeated contrasts within treatment group

<table>
<thead>
<tr>
<th>INTASC Standard</th>
<th>Pre-Mid F</th>
<th>p</th>
<th>Mid-Post F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>59.84</td>
<td>.00</td>
<td>30.82</td>
<td>.00</td>
</tr>
<tr>
<td>Student Learning</td>
<td>29.96</td>
<td>.00</td>
<td>22.79</td>
<td>.00</td>
</tr>
<tr>
<td>Diversity</td>
<td>24.00</td>
<td>.00</td>
<td>16.78</td>
<td>.00</td>
</tr>
<tr>
<td>Instructional Variety</td>
<td>42.53</td>
<td>.00</td>
<td>27.40</td>
<td>.00</td>
</tr>
<tr>
<td>Learning Environment</td>
<td>49.98</td>
<td>.00</td>
<td>20.90</td>
<td>.00</td>
</tr>
<tr>
<td>Communication</td>
<td>38.40</td>
<td>.00</td>
<td>8.50</td>
<td>.01</td>
</tr>
<tr>
<td>Planning</td>
<td>41.76</td>
<td>.00</td>
<td>30.55</td>
<td>.00</td>
</tr>
<tr>
<td>Assessment</td>
<td>56.74</td>
<td>.00</td>
<td>8.94</td>
<td>.01</td>
</tr>
<tr>
<td>Reflective Professional</td>
<td>36.75</td>
<td>.00</td>
<td>3.52</td>
<td>.07</td>
</tr>
<tr>
<td>Partnerships</td>
<td>18.52</td>
<td>.00</td>
<td>10.02</td>
<td>.004</td>
</tr>
</tbody>
</table>

### Table 4

Coach ratings over two years by Interstate New Teacher Assessment and Support Consortium (INTASC) standard -- repeated measures with repeated contrasts within treatment group with years of experience as a covariate

<table>
<thead>
<tr>
<th>INTASC Standard</th>
<th>Pre-Mid F</th>
<th>p</th>
<th>Mid-Post F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>1.99</td>
<td>.17</td>
<td>.33</td>
<td>.57</td>
</tr>
<tr>
<td>Student Learning</td>
<td>.91</td>
<td>.33</td>
<td>.002</td>
<td>.97</td>
</tr>
<tr>
<td>Diversity</td>
<td>.308</td>
<td>.27</td>
<td>2.80</td>
<td>.11</td>
</tr>
<tr>
<td>Instructional Variety</td>
<td>3.87</td>
<td>.06</td>
<td>.004</td>
<td>.95</td>
</tr>
<tr>
<td>Learning Environment</td>
<td>2.92</td>
<td>.10</td>
<td>.000</td>
<td>1.00</td>
</tr>
</tbody>
</table>
There were no significant differences between the treatment and control groups overall on the three efficacy instruments that were utilized in this study: Teacher Self-Efficacy Scale (Bandura, 1998), Teacher Efficacy Scale for Classroom Diversity (Kitsantas, DeBroux, & Concha, 2003), or Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990). However, both treatment and control teachers experienced significant decreases on various (but sometimes different) subscales of the instruments over the course of the study (see Tables 6, 7, and 8). For example, a very informative finding is the extent to which the treatment and control teachers changed in their perceptions of their instructional efficacy. Both treatment and control teachers experienced a declining sense of self-efficacy in instructional skills, but for control teachers this decline was statistically significant (M<sub>pre</sub> = 5.98, SD<sub>pre</sub> = .93, M<sub>post</sub> = 5.38, SD<sub>post</sub> = .88, t(20) = 4.84, p = .000) while the decline experienced among treatment teachers (M<sub>pre</sub> = 5.95, SD<sub>pre</sub> = .75, M<sub>post</sub> = 5.59, SD<sub>post</sub> = 1.01) was not extreme enough to achieve statistical significance. Viewed in conjunction with a comparison of treatment versus control teachers’ student test scores, this finding illustrates the delicate and complicated nature of new teachers’ self-efficacy. It is possible that the control teachers knew their students were not performing well in class, which led to their significant decline in self-efficacy. However, why didn’t the treatment teachers have positive self-efficacy since their students were doing better than control teachers? This question is key. Part of the answer may be that the treatment teachers did not know their students were doing better. Instead, this finding may be attributed to the nature of the supplemental support provided to the treatment teachers. While receiving this support, an unexpected consequence was that the treatment teachers also became aware of areas in which they could improve. This increased awareness of areas in which they could improve may have kept them from experiencing a level of self-efficacy consistent with that of a teacher who truly knows their students are learning and performing well in their classroom.

Table 6
Means and standard deviations for teaching self-efficacy over two years (treatment vs. control)
Table 7
Means and standard deviations for science teaching efficacy over two years (Treatment vs. Control)

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Pre Assessment</th>
<th>Mid Assessment</th>
<th>Post Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treatment</td>
<td>Control</td>
<td>Treatment</td>
</tr>
<tr>
<td>Total</td>
<td>M 2.19</td>
<td>M 2.25</td>
<td>M 2.05</td>
</tr>
<tr>
<td></td>
<td>SD 0.40</td>
<td>SD 0.32</td>
<td>SD 0.39</td>
</tr>
<tr>
<td>PSTE</td>
<td>M 2.00</td>
<td>M 1.91</td>
<td>M 1.59</td>
</tr>
<tr>
<td></td>
<td>SD 0.54</td>
<td>SD 0.49</td>
<td>SD 0.38</td>
</tr>
<tr>
<td>STOE</td>
<td>M 2.37</td>
<td>M 2.56</td>
<td>M 2.48</td>
</tr>
<tr>
<td></td>
<td>SD 0.37</td>
<td>SD 0.30</td>
<td>SD 0.49</td>
</tr>
</tbody>
</table>

Table 8
Means and Standard Deviations for Diversity Self-Efficacy over two years (Treatment vs. Control)

<table>
<thead>
<tr>
<th>Table 8</th>
<th>Diversity Self-Efficacy</th>
<th>Pre Assessment</th>
<th>Mid Assessment</th>
<th>Post Assessment</th>
</tr>
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<td></td>
<td>Treatment</td>
<td>Control</td>
<td>Treatment</td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>M 6.03</td>
<td>M 6.23</td>
<td>M 5.91</td>
<td>M 6.57</td>
</tr>
<tr>
<td></td>
<td>SD 1.59</td>
<td>SD 1.46</td>
<td>SD 1.84</td>
<td>SD 1.21</td>
</tr>
</tbody>
</table>

Additionally, qualitative findings from NSTSN identify a series of challenges teachers face when new to teaching and how to mitigate them. Emergent findings illustrated how teachers’ challenges were situated within the broad categories of classroom management, planning, and instruction. The research also identifies the most vital forms of support for new science teachers which are supportive working conditions, supportive school culture, in-classroom support, and quality courses in how to teach science. These led to a series of policy recommendations for school leaders. During implementation of the program, analysis of qualitative findings, and formation of policy recommendations, the importance of voice and power among members in a CoP became an integral focus, especially as the new teachers interacted within their departments and schools. Consequently, the program’s theoretical framework of a multifaceted culture of
support was expanded to include critical social theory which looks at issues of equity (Bourdieu, 1979, 1984) and new feminist theory which includes socially constructed gender equality (Butler, 1990; Harding, 1986, 1991, 2006; hooks, 1981), as a perspective to emphasize the role of position and power in social interactions inherent in human culture and organizations. Consequently, the policy recommendations provided below are designed to empower new teachers as an active, valued member of their CoPs overlapping their classrooms, departments, schools, school districts, university partnership, and larger community.

**Ways to Reduce New Science Teacher Attrition and Increase Student Performance**

Emergent qualitative findings from the NSTSN identified a series of challenges teachers face when new to teaching and how to mitigate them. The NSTSN research also identified the most vital forms of support for new science teachers which are supportive working conditions, supportive school culture, in-classroom support, and quality courses in how to teach science.

*Principle 1. Establish Supportive Working Conditions*

The greatest resources are committed administrators and senior teachers who establish a collegial atmosphere where all teachers support those new to the profession. This means setting up policies and procedures to provide positive working conditions and support for new teachers to succeed at teaching. It also means minimizing the seniority system where senior teachers get easy working conditions at new teachers’ expense.

Teacher attrition can be reduced through attention to improving new science teachers’ working conditions. Through improved working conditions, new science teachers are provided the time they need to learn how to teach well.

While it is tempting to hold off until the last possible day to hire an underprepared teacher in hopes of finding one who is more prepared, valuable training and planning time is lost. Administrators must weigh the potential benefit of hiring underprepared teachers early so that they can participate in summer professional development opportunities or prepare for teaching by reviewing school curriculum guidelines, surveying science equipment and materials, planning initial lessons, and setting up the laboratory. New teachers hired late start off teaching with a distinct disadvantage.

Careful thought needs to be given when developing teaching assignments for new science teachers. Science teachers have additional preparation time compared to teachers in other disciplines since science teachers must provision for regular classroom instruction plus laboratory-based instruction. New science teachers need to be assigned fewer different types of classes to teach so that the teacher can adequately prepare for inquiry-based, hands-on science instruction. By teaching only one type of science class (e.g. regular education chemistry), new science teachers have time during the teaching day to reflect on their teaching effectiveness. This in turn allows them to adjust their teaching during the day to increase student learning. Instead, if the teacher is getting ready to teach another type of class (e.g. a lower level chemistry course with a curriculum different from the regular course or, worse yet, a different science altogether
such as biology), they do not have time to reflect and revise their plans between classes. This also increases chances for compromising students’ laboratory safety.

Room assignment is important to science teachers. New science teachers need to be assigned rooms that are purposely designed for science instruction. They need to be able to teach in one room so that they are not spending their time provisioning for the same science activity in different rooms. Consider having veteran teachers take on the extra burden of changing rooms instead of new teachers.

Since new teachers need extensive time to plan for effective teaching, it is especially important that new teachers not be asked to do additional duties such as coaching sports or coordinating the science fair. Administrators and senior teachers must be cognizant of the extra time it takes new teachers to plan for regular instruction plus laboratory-based instruction, and extra duties beyond those related to science teaching should not be assigned.

Findings from six years’ worth of data repeatedly highlight the importance of providing new science teachers with supportive working conditions that allow them time to thoughtfully prepared and reflect on their teaching.

Principle 2. Provide Adequate Support
Effective school leaders create school environments that nurture new teachers to succeed at teaching and reach their potential. In addition to setting up favorable working conditions for new teachers, there are three general forms of support: first week information, resource support, and teaching support. Most school divisions do a good job of providing information teachers need the first week, but this is often where support ends. Establishing a plan and identifying a person responsible for providing this information will help new teachers with tasks such as taking attendance using the school system’s protocols, knowing procedures for making photocopies, and meeting resource personnel.

Another form of support is providing resources to enable teachers to teach. This goes way beyond informing teachers how to obtain textbooks, paper, and pencils. Depending on the technology available, resources range from overhead projectors, transparency pens, and transparencies to computers with projection systems. In addition to having the equipment, new teachers need someone to model effective use of equipment. Additionally, science supplies are needed to conduct science experiments. In order for students and teachers to conduct experiments, teachers need to know what science supplies and equipment should be found in all science classrooms, and the location of shared science supplies. Having easy access to supplies needed for teaching will enhance new teachers’ effectiveness and likelihood of actually having students conduct laboratory experiments.

The most crucial form of support for new science teachers is providing them with coaching in order for them to perfect their teaching and enhance student learning. Retired science teachers who were highly effective at teaching are one group not to overlook as a source of support because many have skills, knowledge, and time to work with new teachers. Retirees can observe classroom teaching and provide support throughout the school day (Dunne & Newton, 2003; Heller, 2004) to ensure that science instruction is safe and effective. In addition, they can identify
when a teacher is being treated poorly and serve as an advocate. Free of the constraints of teaching their own students, retired science teachers have both the time and the knowledge to make a difference. Additional possibilities are teachers on extended maternity leave or teachers who are fully released from their own teaching to help new teachers. From this group, retirees are often the most abundant, cost-effective, and knowledgeable resources with time to focus on mentoring new teachers.

The experiences of new science teachers chronicled over a span of six years highlights again and again the importance of establishing a three-stage mechanism of support (first week information, resource support, and teaching support) that nurtures new teachers to succeed at teaching and reach their potential – otherwise, many new teachers give up.

Principle 3. In-Class Support is Key to Success

From our work with teachers in the New Science Teachers’ Support Network (NSTSN), there is not a generic model for supporting new science teachers. However, data from the NSTSN reveals that in-class support has a major positive impact on teaching efficacy and performance as well as student achievement.

In-class support for new science teachers makes a difference in teaching and student learning. For new science teachers to become effective quickly, they need in-class guidance while they are learning to teach and help in planning. This is especially important as many new teachers are entering teaching without education coursework or student teaching. Retired science teachers can serve as a resource for training new teachers in this manner.

Free of the constraints of teaching their own students, retirees are able to help new science teachers plan effective lessons before, during, and after school as the new teacher’s schedule permits. At the beginning of the year, retirees help teachers establish effective classroom management routines. Experienced with the curriculum, retirees help new teachers with both long range and short range planning. In terms of long range planning, retirees help new teachers develop their understanding of the conceptual flow and pacing of curriculum. In terms of daily planning, retirees have experienced the ways in which student misconceptions occur and can help new teachers address and prevent students’ misconceptions.

Retirees can help new teachers identify strategies for teaching and organizational ideas for laboratory activities. Sometimes retirees help new teachers find needed science equipment that already exists in their school. Other times, retirees may perform an experiment with new teachers before they use it with students to ensure that the teachers are familiar with laboratory protocol. In terms of students’ safety and access to quality instruction, new teachers must physically perform laboratory procedures themselves before using the equipment with students. Busy new teachers may skip this step, but a retiree can ensure that this occurs.

Planning can also include the development of opportunities for the retiree to model particular techniques during a lesson. If new teachers are hesitant to give up their role temporarily in the classroom for a retiree to model effective teaching, new teachers usually feel more comfortable if they have shared in the development of the parameters for when and how the retiree will teach. For example, retirees can model how to effectively ask questions or raise students’ level of
awareness of safety by teaching a short segment of class. Since science teachers utilize tools and hands-on materials, they need to be especially vigilant and effective managers of the classroom.

The importance of in-class support was continually evident in our study of new science teachers. Retirees were an invaluable resource in the lives of their new science teachers and the bonds forged resulted in better teaching and better student performance. Preparing to teach science involves the unique challenge of preparing for instruction that involves teaching concepts with science equipment and supplies. New science teachers need in-class support from knowledgeable professionals such as retired science teachers – otherwise, their students suffer academically.

**Principle 4. Provide quality training in how to teach science**
Training in how to teach science goes beyond just immediate support in the classroom to help the new teacher survive. Providing a well organized course to help new teachers see the “big picture” of teaching, assessment, and research on effective instruction is needed to help teachers look at teaching from a professional perspective. New teachers need help to plan lessons, identify effective teaching strategies, organize laboratory activities, identify common misconceptions of students, assess learning, and adapt lessons to the special needs of learners including English language learners. By taking courses in science teaching, new science teachers were able to perfect their teaching and enhance student learning.

Teachers have a daunting task. They must be instructional leaders, curriculum and assessment experts, special needs advisors, cheerleaders, educational visionaries, and change agents. Growing expectations for teachers to successfully teach a broad range of students with different needs and steadily improving achievement mean that classrooms and teaching typically must be redesigned rather than merely continuing as in the past. Science teachers are especially challenged in that they must incorporate science equipment and materials into their instruction which provides an additional dimension to their teaching demands.

In addition to teachers needing training, those whose task is to provide in-class support to new science teachers also need training and time to share what works and what doesn’t for new classroom teachers. Working with adults requires a different set of skills than working with children. Retirees who are recently retired exemplary classroom science teachers have the knowledge and time to provide support for new teachers. They also can take pride in giving back to the profession what they have learned during their teaching career.

The research data indicate that quality training for new teachers is needed in how to teach science and assess learning for all students. With instructional coaching, new science teachers thrive and flourish in the classroom. Those who provide in-class support to new teachers also need to be incorporated into planning for training of new teachers. New teachers may know science content, but not how to effectively teach it. Further findings illustrate that the students of new teachers suffer academically, and in worst cases there is chaos in the science classroom.

**Recommendations for School Leaders**

Effective school leaders create school environments that nurture new teachers to succeed at teaching and reach their potential. Our research suggests the following policies and practices:
Pay Attention to Working Conditions

- Hire early and assign classes so that the new teacher can start planning to teach before they have to start school.
- Assign new teachers only one class preparation so they have time to reflect and revise lessons between class periods to perfect their teaching skills.
- Provide new science teachers their own room in which to teach instead of having them float between classrooms with a cart.
- Protect new teachers from additional school duties beyond those directly related to teaching their own classes.

Provide Support

- Nurture new teachers in a supportive school environment where teachers help each other and the entire faculty is focused on helping students.
- Establish a plan and identify a person or team to provide new teachers with an orientation to the school, policies, and procedures.
- Provide teaching resources including teaching supplies, computer equipment, and science equipment, along with a person to demonstrate effective equipment use.
- Provide an in-class coach/mentor to support the new teachers while learning to teach, such as a retired science teacher with experience teaching the same content area as the new teacher who has time to observe the new teachers teaching over an extended period of time and suggest how to more effectively impact student learning.

In-Class Support

To encourage effective teaching and learning, coaches/mentors who spend extended time in and out of the classroom with the new teacher can:

- Observe new science teachers teaching and provide constructive feedback,
- Assist in establishing classroom routines,
- Problem solve classroom management challenges,
- Share about the school’s culture,
- Participate in long and short-term planning with emphasis on sequence and pace,
- Identify students’ common misconceptions and assist with planning to mitigate them,
- Provide lesson ideas, materials, and equipment or help locate equipment,
- Perform experiments with new science teachers prior to use with students,
- Model effective, safe instruction for large and small groups, and
- Focus on increasing student learning.

Quality training

- Establish a partnership with a local college or university to provide quality courses for new teachers in how to teach and assess science.
- Provide quality training for those who provide in-class support in how to support and mentor new teachers.

Through our work with new science teachers in the NSTSN, we have found this set of recommendations for establishing supportive working conditions, supportive school culture, in-
classroom support, and quality courses in how to teach science makes new science teachers more aware of what they must do to be effective teachers, supports an increase in their instructional competency, and results in statistically significant better student achievement as compared to new science teachers without the support. Teaching is a daunting task for new teachers, especially those not prepared for teaching. Dedicated school leaders can be champions for new science teachers and set up working conditions and supportive infrastructures to help new teachers succeed at teaching and remain in the profession.

**Implications**

This study has implications for teacher induction as shortages of science teachers increase and school systems hire uncertified teachers who have degrees in science, but little or no educational training or experience teaching. These new teachers are usually placed in the classroom in a sink-or-swim situation where they are expected to learn through trial and error what works in teaching children. This is not an efficient method of providing quality teaching for children or training for teachers and results in 66% of these inexperienced teachers leaving the profession within the first three years they are in the classroom (Darling-Hammond, 2003). This study identifies challenges of new, uncertified science teachers and forms of support that matter most, so that school personnel will be better able to assist under-prepared teachers to succeed at teaching and remain in the profession.

NSTSN provided multiple forms of support to new, uncertified teachers in the treatment group in order to increase uncertified teachers’ confidence and effectiveness as science teachers as well as their students’ science learning and performance. Data indicate that teachers receiving the supports of the NSTSN experience significant growth in their instructional skills. Additionally, data on student performance indicates that new, uncertified teachers receiving support of NSTSN have students who perform better on standardized tests and course grades than their control counterparts as evidenced by test results from 5,839 students and course grades from 10,367 students. However, this study extends beyond test scores and course grades to assess impact of program components on teachers’ self-reported, self-efficacy beliefs as a measure of their potential for remaining in the profession while providing concrete, hard evidence from direct observations in classrooms to determine teachers’ instructional skills and how these change over a two-year period. While it was hypothesized that teachers in the treatment group would show higher self-efficacy beliefs to teach science and students from diverse backgrounds, findings reveal the fragile nature of efficacy among this population and illustrate the need for continued planning within university-school partnerships to address this issue.

From this research emerges a set of suggested policies and practices for school leaders to establish supportive working conditions, supportive school culture, in-classroom support, and quality courses in how to teach science that make new science teachers more aware of what they must do to be effective teachers, support an increase in their instructional competency, and result in statistically significant better student achievement as compared to new science teachers without support. Teaching is a daunting task for new teachers, especially those not prepared for teaching. Dedicated school leaders can be champions for new science teachers and set up working conditions and supportive infrastructures to help new teachers succeed and continue teaching.
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References


Association for the Advancement of Science. Accessed November 21, 1999 at http://ehrweb.aaas.org/ehr/projectalliance/


