

## Supporting New Science Teachers: What School Leaders Can Do

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### The Challenge of New Science Teacher Attrition

Nationally, there is a growing shortage of science teachers. As a result, many school districts are forced to hire teachers with science degrees but little training in education or experience teaching. These ill-prepared, new science teachers face the extra challenge of discovering how to teach on their own. Without effective support, research shows that 66 percent of these new teachers will quit the profession within three years (Darling-Hammond, 2000, 2003). What can school leaders do to support new science teachers?

The New Science Teachers' Support Network (NSTSN) is a collaborative effort among George Mason University and local school divisions to help uncertified science teachers succeed at teaching and remain in the profession. Research findings from the NSTSN reveal that **students enrolled in the classes of teachers who received support performed significantly better on the Virginia Science Standards of Learning tests** than students enrolled in the classes of a comparable set of new science teachers who did not receive support ( $M_T = 37.50$ ,  $SD_T = 8.26$ ,  $M_C = 35.80$ ,  $SD_C = 8.53$ ,  $t(5837) = 7.61$ ,  $p = .000$ ). Though the purpose of schools is to help students learn, in some cases the best way to help students is to help teachers.

#### *Why New Science Teachers Leave*

Science teachers experience greater job dissatisfaction and are more likely to leave the profession compared to other subject area teachers (Ingersoll, 2000). The National Science Teachers Association (2000) found that the main reason teachers leave teaching is job dissatisfaction, with "poor administrative support" cited as a major reason for dissatisfaction.

#### *The Consequences of Science Teacher Attrition*

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, and assess learning.

### Description of the Research Study

The goals of the New Science Teachers' Support Network (NSTSN) are to help uncertified science teachers succeed at teaching and to remain in the profession. The 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, the NSTSN chronicled the experiences of 53 uncertified teachers in three large, urban-suburban school districts and the people supporting them to determine how the new teachers' needs were addressed and the consequences of those actions.

Each teacher was uncertified with a bachelor's degree in science and limited teaching experience, but granted a "provisional license" from the state so that they could be legally hired by the state's school districts as full-time teachers. Teacher participants (female, N=29; male, N=24) ranged in age from 23 to 66 years, with a mean age of 34.2 years. There were 45 Caucasians, 3 African Americans, 3 Asian Americans, and 2 of mixed ethnicity. Upon entry into the program, teachers were randomly assigned to treatment and control groups (treatment, N=30; control, N=23) and committed to participating in the study for two years. Both the 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, the 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.

Both qualitative and quantitative data were collected 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.

The quantitative data were analyzed using SPSS and Microsoft Excel software. Qualitative data were analyzed using NVivo software 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). The emergent themes were further analyzed using Microsoft Excel spreadsheets to graphically analyze data for patterns in change over time.

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

Research 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 science 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 providing 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.

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