Introduction

Teacher quality is an essential factor in preparing high school graduates to learn, live, and work in a technological, scientifically advanced society. As such, science teachers have a significant role in preparing future generations of citizens who have the knowledge and skills to solve problems and make decisions that affect the quality of life of all living things on the planet Earth. Retention of highly qualified high school science teachers is a mounting concern confronting the nation. Estimates are that we could lose a third of the nation’s most accomplished educators in the next four years due to retirement and other factors, which include better working conditions at other places of employment, better pay and benefits, and more opportunities for advancement in the profession.

Background and Purpose

In response to the projected national needs to recruit and retain highly qualified science teachers, the National Science Foundation in 2004 requested proposals for research to investigate issues associated with the teacher professional continuum (TPC) of science teachers. The National Science Foundation accepted a research proposal submitted by Texas A&M University in spring 2005 to investigate issues of teacher quality and teacher retention among Texas high school science teachers.

Funds from the National Science Foundation supporting the Policy Research Initiative in Science Education (PRISE) were awarded to Dr. Carol Stuessy (Principal Investigator) and Drs. Jim McNamara and Tim Scott (Co-Principal Investigators). In their proposal, these researchers identified four critical school practices related to high school science teacher quality and teacher retention: recruitment, induction, renewal (professional development), and retention. As recommendations for practice are often customized to meet the needs of science teachers with different levels of teaching experience, three types of teachers were also identified: (1) induction-year teachers (i.e., teachers in their first three years of teaching); (2) mid-career teachers (i.e., teachers with four to eight years of teaching experience); and (3) veteran teachers (i.e., teachers with more than eight years of teaching experience).

The PRISE Research Group was formed in the fall of 2005 to describe the state-of-the-state of the high school science TPC in Texas. This policy brief explains the procedures and methods used by the PRISE Research Group to investigate policies and practices in Texas high schools related to the retention of highly qualified high school science teachers in the TPC.

Time Line

The PRISE Research Group proposed an ambitious research agenda. The first year included recruitment of teachers as graduate research partners, literature review and conceptual framework development, and design of a sampling plan. The second year’s activities prepared the group for school-based data collection, which occurred in the third year of the project. Data analysis and report preparation occurred in the fourth year of the project. The fifth year’s activities included dissemination of findings. The PRISE Research Group is currently beginning its fifth and final year of the project.

<table>
<thead>
<tr>
<th>Year</th>
<th>Activities</th>
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<tbody>
<tr>
<td>1</td>
<td>Recruit teachers as graduate research partners as members of the PRISE Research Group</td>
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<tr>
<td></td>
<td>Begin the literature review and concurrently develop the conceptual framework</td>
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<tr>
<td></td>
<td>Design the sampling plan</td>
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<tr>
<td>2</td>
<td>Select data sources to provide state-of-the-state information</td>
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<td></td>
<td>Establish protocols for collecting school- and teacher-level data</td>
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<td></td>
<td>Design, pilot-test, and revise teacher questionnaire</td>
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<td>3</td>
<td>Hold PRISE Network School meetings and follow-up visits for recruiting schools to participate</td>
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<tr>
<td></td>
<td>Visit schools and collect school-based data</td>
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<td></td>
<td>Develop a system for maintaining databases of quantitative and qualitative data</td>
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<tr>
<td>4</td>
<td>Analyze data</td>
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<tr>
<td></td>
<td>Write research reports</td>
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<tr>
<td></td>
<td>Write dissertations</td>
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<tr>
<td>5</td>
<td>Hold stakeholders’ meetings</td>
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<tr>
<td></td>
<td>Disseminate findings through policy briefs</td>
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<td></td>
<td>Reach consensus regarding policy recommendations</td>
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Procedures and Methods

Recruitment of teachers as graduate research scholars

The grant from the National Science Foundation awarded for the PRISE research included fellowships for eight high school science teachers to pursue doctoral degrees in science education policy research while engaging in research associated with the high school science TPC in Texas. In the spring and summer of 2005, eight graduate fellows were recruited to begin their work on the PRISE project in the fall of 2005. Experienced high school science teachers, these members of the research group functioned as “reality checks” in the earliest stages of the process. Currently finishing their dissertation studies, PRISE Research Fellows have provided their expertise as high school science teachers in the design, implementation, and analysis of data related to the high school science TPC in Texas.

Three basic policy research questions guided the planning, implementation, and analysis associated with the ambitious research plan of PRISE Research Group:

- Where are we?
- Where should we be?
- How do we get there?

Figure 1 provides an overview of the PRISE Research Agenda, detailing School, State, and United States data used to answer the first policy research question and stimulate discussions in an answer to the second and third. The purpose of the series of policy briefs planned for this school year (2009-2010) is to move the conversation along from the second question to resolutions for answering the third question.

Literature review and conceptual framework development

Literature review and conceptual framework development have served as the “glue” that has embedded the planning, implementation, and completion of group research projects and individual dissertations of graduate research scholars. Early in the fall of 2005, the PRISE Research Group began the process of defining and delimiting the aspects of their investigations.

The concurrent processes of literature review and framework development have brought the group research activities to the level of being able to describe “where we are” in the high school science TPC. The group’s literature review process has been thorough, substantive, and sophisticated (Boote & Beile, 2005), demonstrating the generativity described by Shulman (1999):

Generativity is the ability to build on the scholarship and research of those who have come before us. Generativity grants our work integrity and sophistication. To be useful and meaningful, education research must be cumulative; it must build on and learn from prior research and scholarship on the topic. (p. 3)

The grounding provided by literature review and conceptual framework development allowed the TPC Research Group to remain centered in the midst of collecting and analyzing data from multiple data sources and to create research products having implications for policy in strengthening the high school science TPC. The PRISE Research Group has experienced first-hand the argument offered by Eisenhart in Lester (2005, p. 450):

Conceptual frameworks are not constructed of steel girders made of theoretical propositions or practical experiences; instead they are like scaffolding of wooden planks that take the form of arguments about what is relevant to the study and why . . . at a particular point in time. As changes occur in the state-of-knowledge, the patterns of available empirical evidence, and the needs with regard to a research problem, used conceptual frameworks will be taken down and reassembled.

Figure 1 displays the current conceptual framework, which has been reviewed and revised continuously since the fall of 2005. This framework reflects the current thinking of the PRISE Research Group in terms of relationships between and among critical elements in describing the current state-of-the-state in terms of the high school science TPC in Texas.
who collaboratively develop, test, and revise the school’s practices and policies that support the recruitment, induction, renewal (professional development), and retention of high school science teachers. These practices and policies incorporate collaborative strategies, which were identified from the literature as strongly influencing the quality of the work environment for teachers at all stages in their careers. These strategies include building professional supports outside the walls of the school, supporting professional relationships within the walls of the school, enhancing the working conditions of science teachers, and providing science teachers with facilities and materials in a safe environment for teaching and learning science. Outcomes associated with successful high school science settings include high levels of high school science teachers’ job satisfaction and retention and high levels of high school science students’ achievement in science.

Design of the sampling plan

The Texas public school population exhibits diversity in both location and student demographics. A scientifically derived sampling plan using both of these features can yield a representative sample of only a few public schools to produce an accurate picture of the entire population of Texas public high schools. The PRISE Research Group used a modified random stratification sampling procedure to identify a scientific sample of 50 Texas high schools to represent the 1,333 schools in Texas that offer high school science courses taught by high school science teachers. Figures 2 and 3 display school distribution maps of the target population of 1,333 Texas high schools (Figure 2) and county locations for the 50 PRISE sample schools (Figure 3).

Recruitment of participating schools

PRISE Network Meetings of principals and science teachers from prospective samples school were held in the fall of 2007. At network meetings, schools heard about the overall plan and were requested to participate in the PRISE research. School contacts were made shortly thereafter by PRISE Research Scholars, who requested interviews of principals and teachers and permission to deliver questionnaires to the high school science teachers at the school.

Schools’ agreements to participate as sample schools in the PRISE research project resulted in different return rates by size of school (Table 1). To replace the eleven schools that did not agree to participate, similar schools were chosen as replacements to reflect the same selection criteria (i.e., size, student minority proportion, and geographic location) as the original sample schools. With the addition of the eleven replacement schools, a 100 percent return rate was achieved. Table 2 reflects participation status for the 50 sample schools chosen to representing the 1,333 schools in Texas.

Selection of data sources

The PRISE Research Group implemented a research plan that involved intensive data collection at the 50 school sites. From the 50 schools, PRISE Research Scholars chose seven to nine
schools as their data collection sites. Data sources at the school site included the following:

- Surveys from science teachers (n=385) in the sample schools regarding their levels of engagement in professional activities and job satisfaction
- Face-to-face interviews with principals regarding aspects of the school’s recruitment, induction, renewal, and retention of high school science teachers
- Face-to-face interviews with science teacher liaisons regarding the science program at the school
- Telephone interviews of teachers with more than three years of teaching experience who were in their first year at the school
- Telephone interviews of novice teachers in their first three years of science teaching
- Telephone interviews of teachers identified as mentors of new teachers
- Archived data from school master schedules
- Archived data in state-level databases managed by the Texas Education Agency

Figure 4 indicates the flow of information from conceptual framework and sampling plan, through data sources and data transformations, and finally to stakeholders’ research reports which were presented in September 2009.

Teachers who are satisfied with their current teaching positions are less likely to move to another school or leave the profession (Stockard & Lehman, 2004); and they are also more likely to contribute to the professional culture of the school (Kardos, Johnson, Peske, Kauffman, & Liu, 2001). Teachers who actively contribute to the professional culture also assist in sustaining the workforce by recruiting, mentoring, and providing professional development to other science teachers. Contributions of professionally committed science teachers should not be underestimated, as they can play significant roles in supporting and retaining teachers in the high school science TPC. (For more information, see Carroll & Foster, 2009; Carver & Feiman-Nemser, 2008; Grossman, Wineburg, & Woolworth, 2001; Kahle & Kronebusch, 2007; Kardos et al., 2001).

Given the current losses of Texas high school teachers and projections for increases in teacher retirement, it is especially important to understand aspects of the work environment contributing to the satisfaction of teachers and to the professional culture of the school. The PRISE Research Group used the conceptual framework and literature as guides to develop a questionnaire to assess science teachers’ current levels of satisfaction with their work environment. The group developed, tested, and revised the Texas Poll of Secondary Science Teachers. Figure 5 summarizes the process of developing the poll that included literature review, categorization of policies and practices, development of the conceptual framework, authoring of white papers, and iterative processes of discussion and item development.

Figure 5.

![Diagram summarizing the process of developing the Texas Poll, displaying the central role of the conceptual framework in defining domains of practice and their indicators (see http://prise.tamu.edu).](http://prise.tamu.edu)

The Texas Poll requested information about (a) teachers’ job satisfaction and (b) involvement in professional activities. Six types of involvement were identified: new teacher recruitment, new teacher induction, leadership activities, science-specific
professional development, professional activities specific to science or science education, and participation in general (non-science) professional activities. Fourteen Likert-type questions regarding a teacher’s job satisfaction with their school included these categories: satisfaction with autonomy and recognition; satisfaction with the physical environment; satisfaction with collegiality and cooperation; satisfaction with administrative support; and satisfaction with the school’s focus on students.

In visits to the sample schools, PRISE Scholars distributed the questionnaires to science liaisons, who were often the ones responsible for returning questionnaires to the PRISE Scholars. In some cases, PRISE Scholars returned to schools to pick up additional questionnaires in order to assure involvement of all teachers desiring to participate in the poll. In other instances, individual teachers mailed their completed questionnaires back to Texas A&M University. Each teacher received a small stipend for completing the questionnaire. Overall return rates from teachers at sample schools approached 90 percent (89.2%). About nine out of ten teachers returned polls in Small and Large schools, while about eight out of ten teachers returned polls in Medium schools. (See Table 2.)

Other statistical details about the poll include the following: Cronbach’s alpha (α = 0.862) was calculated as a measure of internal consistency, supporting the researchers’ claims that the instrument was reliable; factor analysis of the 14 job satisfaction questions revealed four components accounting for 60.6% of the variance in teacher responses.

### Table 2
Overview of teacher return rates for the Texas Poll of Secondary Science Teachers

<table>
<thead>
<tr>
<th>School Size</th>
<th>School Count (n)</th>
<th>Teacher Count (n)</th>
<th>Polls Returned (n)</th>
<th>Rate of Return (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>15</td>
<td>26</td>
<td>24</td>
<td>92.3</td>
</tr>
<tr>
<td>Medium</td>
<td>17</td>
<td>87</td>
<td>74</td>
<td>85.4</td>
</tr>
<tr>
<td>Large</td>
<td>18</td>
<td>272</td>
<td>245</td>
<td>90.1</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>385</td>
<td>346</td>
<td>89.2</td>
</tr>
</tbody>
</table>

Database development and management

Data quickly accumulated during collection. The PRISE Research Group developed a data naming system to identify sources and types of data, following the general format:

School Number_Type of Data_

Most interviews were audio-recorded, which required transcription and translation into data charts. In all cases, interviewers took field notes, which stood alone as a data source in cases where interviews were not audio-recorded. Field notes were transcribed and added to the collection of interviews. Individual teachers’ responses on questionnaires were transferred to data sheets, entered into the computer as an SPSS file, verified by pairs of researchers, and corrected by the data entry person. Archived information from state-maintained databases was selected, entered into data charts, and entered as items into separate databases.

A system of checks and balances assured that data sources were named and filed correctly. Back-up data files were produced on external hard drives for each member of the PRISE Research Group. A locked filing cabinet holds hard copies of all data sources. All identifying information was removed from data sources to assure confidentiality of information.

Research Reports and Dissertations

Four research reports were prepared during Year 4 for dissemination at a stakeholders’ meeting in Dallas, Texas, in September 2009. Three of these reports draft information to answer the first policy research question (Where are we?) in regarding to the current state-of-the-state of the Texas high school science TPC. A fourth document was developed to assist policy makers in beginning the conversation about the second research question (Where should we be?). All are currently on the PRISE website (http://prise.tamu.edu).

- **Policies and Practices of Texas High Schools in the Recruitment and Retention of Texas High School Science Teachers** couples information from interviews of the 50 sample schools of high school principals and science teachers with archived data from school master schedules and state-maintained databases. Results are reported in chart essay format (see Haensley, Lupowski, & McNamara, 1987).

- **Professional Practices and Job Satisfaction of Texas High School Science Teachers** provides the results of data from science teachers’ responses to questionnaires about their involvement in professional activities and satisfaction with their current teaching positions. Results are reported in chart essay format (Haensley et al., 1987).

- **Settings for High School Science in Texas** provides mini-portraits (see Lawrence-Lightfoot & Hoffmann Davis, 1997) or sketches describing the science teaching and learning environments of the 50 sample schools. All data sources were used to create short descriptions to provide holistic “sketches” of the schools that focus on the elements identified in the conceptual framework as major contributors to job satisfaction and retention of high school science teachers and a school’s success in science achievement as measured by a number of state indicators of school success.

- **Voices in Schools** is the fourth document, which was developed to assist policy makers in answering the second research question, Where should we be? This report used the voices of individuals from three Texas high schools to describe “good” policies and practices (see Lawrence-Lightfoot, 1985) that have already been advanced to recruit, induct, renew, and retain teachers while also providing for students’ science learning needs.

Dissertations are in progress. One PRISE Scholar completed her dissertation and currently continues research on the high school science TPC at another university. Five other PRISE Scholars are completing their dissertations that deal with aspects of the PRISE research agenda, ranging from complex statistical methods to descriptions of high school recruitment practices. Policy briefs such as this one will be published periodically during this fifth year to sustain interest and conversation about the development of TPC policies to alleviate shortages and improve the quality of high school science teaching in Texas.
Dissemination and Dialogue

A PRISE Dialogue Forum was held at the American Airlines Training Center in Arlington, TX on September 13-14, 2009. Sixty stakeholders in high school science education reviewed the four policy research documents described above, attended dialogue sessions to discuss findings, and began the conversation about policy alternatives to support and retain Texas high school science teachers in the TPC. In the 2009-2010 school year, PRISE policy briefs will be periodically published as we continue the conversation about policy alternatives to alleviate high school science teacher shortages and enhance teacher quality. Individuals interested in becoming a part of the conversation should contact Carol Stuessy at Texas A&M University to receive periodic updates and attend the conference scheduled for late September or early October in 2010.

Overview of Policy Brief #2

Table 3 summarizes findings from the PRISE Research Group about the mobility of high school science teachers in Texas. About one third of Texas teachers in their first three years of teaching left their current schools to change jobs or leave public school teaching at the end of the 2007-2008 school year. Roughly one in five teachers with more than three years of teaching experience left their current schools. Teachers moved to another school or left the Texas public school system at rates ranging from 35 percent for induction-year teachers, 23 percent for mid-career teachers, and 20 percent for veteran teachers.

<table>
<thead>
<tr>
<th>Mobility Status</th>
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<th>Migration</th>
<th>Attrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IY ≤ 3 (%)</td>
<td>MC 4-7 (%)</td>
<td>MC ≥ 8 (%)</td>
<td>Known (%)</td>
</tr>
<tr>
<td>Retention</td>
<td>65.6</td>
<td>77.0</td>
<td>80.8</td>
<td>60.0</td>
</tr>
<tr>
<td>Migration</td>
<td>14.6</td>
<td>14.8</td>
<td>8.0</td>
<td>16.7</td>
</tr>
<tr>
<td>Attrition</td>
<td>19.8</td>
<td>8.2</td>
<td>11.2</td>
<td>33.3</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
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Table 3
Mobility of Texas high school science teachers in PRISE Sample Schools by profession type between 2007-2008 and 2008-2009 school years

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See Mobility of High School Science Teachers in Texas, PRISE Policy Brief #2, for research results related to the mobility of high school science teachers. Texas schools continue to face increases in the numbers of children entering school, changes in state-level policies requiring science courses for graduation, implementation of new accountability measures, and compliance with rules regarding laboratory experiences in science courses. Mounting pressures increase our needs to know about practices and policies in Texas that (a) support and sustain highly qualified high school science teachers and (b) affect teachers’ reasons for leaving or staying in their current teaching positions.

Literature Cited


Contact

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