51 Math and Science Teachers in Texas:

Motivating, Preparing, Supporting, and Retaining Math and Science Teachers in Texas High Schools

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A report by the
Sid W. Richardson Foundation Forum

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Foreword

For over twenty years, the Sid W. Richardson Foundation Forum has served as a Foundation think tank devoted to the examination of critical issues related to educational reform and improvement in our state. Over this time, we have particularly concentrated on issues of human capital development—educator preparation, professional development, and support— that affect the quality and effectiveness of the professional workforce in Texas schools. In past Forum studies, we have been privileged to work with many of the state's foremost educators and policy leaders. The information, frank dialogue, and mutual "learnings" derived from this work together have proven to be highly instructive and beneficial to the Foundation. The study of 51 math and science teachers in Texas high schools is no exception.

In this report, the Forum presents another in its series of white papers related to issues of teacher preparation, professional development, and support. In this instance, our work specifically addressed high school science and math teachers of Texas, whose numbers continue to constitute one of the most perplexing shortage areas in our schools. To understand the nuances of this particular issue, the Foundation chose to go directly to the heart of the matter by engaging a sample of new science and math teachers and learning directly from their experiences and perceptions as they began their teaching careers in Texas high schools. In this examination, we sought to examine practical, work-a-day issues and authentic perspectives of classroom teachers, and in doing so, we believe that we were able to attain considerable insight. This report synthesizes the major findings of our longitudinal examination of the experiences of 51 Texas teachers of math and science. The study is intended to delineate the major issues encountered from the perspective of these teachers as they embarked on careers in Texas high schools and to offer suggestions and recommendations for improving our recruitment and retention of teachers for math and science classrooms.

It has been our pleasure to work with and get to know the 51 teachers involved in this study. We have learned much from them. The stories of these teachers and their suggestions for improvements have definitely inspired us and illuminated our thinking here at the Foundation. We are grateful to these teachers as well as to the principal investigators who have worked on this project. We hope that the findings reported here will be instructive to other educators who have interest
in the development of math and science teachers.

There is much more to be considered in this area, and Texans must be particularly involved and vigilant about matters of our educator workforce during these financially challenging times. Our experiences in this study, however, remind us that Texas is blessed with many fine and dedicated educators who teach in our high schools. They do this out of desire to make a genuine contribution to the education of the young people whom they serve, and, thank goodness for us all, most sustain a remarkably resilient and dedicated professional spirit that keeps them coming back for more! They deserve the respect and support of all of us, in every community, in every school.

Valleau Wilkie, Jr.
Co-Chair, Sid W. Richardson Foundation Forum
Former Executive Vice-President, Sid W. Richardson Foundation
(Mr. Wilkie retired from the Foundation in June 2011.)

About the Sid W. Richardson Foundation Forum

Founded in October 1990, the Sid W. Richardson Foundation Forum provides a venue for leaders from schools, business, government, universities, and foundations to discuss education reform. 5*1 Math and Science Teachers in Texas: Motivating, Preparing, Supporting, and Retaining Math and Science Teachers in Texas High Schools* is the seventh report published by the Forum since its inception. It was written by Linda J. Reaves, Vice President, TCES & Associates, Inc., and William E. Reaves, Co-Chair of the Forum, using findings from the initial three-year study by Jo Ann Wheeler and David Eschberger (2008) in conjunction with data collected in the five-year follow-up study. The six earlier publications of the Forum are identified below.

1990, *The Professional Development School: A Commonsense Approach to Improving Education*, Forum Members

1997, *Restructuring the University Reward System,* Forum Task Force

1997, *Principals for the Schools of Texas: A Seamless Web of Professional Development,* David A. Erlandson

2001, *Excellent Teachers for All Texas Schools: Proposals for Engaging Educational Stakeholders in Concerted Action*, Forum Advisory Committee

2002, *Superintendents for Texas School Districts: Solving the Crisis in Executive Leadership*, John R. Hoyle

2009, *Delivering a High-Quality Teacher Workforce for Texas: Reconsidering University-Based Teacher Preparation in Texas, Renewing Commitments, and Improving Practice in the Twenty-First Century*, Forum Advisory Committee, William E. Reaves, editor

For information about the Forum or its publications, contact:

Mr. Valleau Wilkie, Jr., Co-Chair, Sid W. Richardson Foundation Forum
Former Executive Vice-President, Sid W. Richardson Foundation
druffu@sundancesquare.com

Dr. William E. Reaves, Co-Chair, Sid W. Richardson Foundation Forum
william-reaves@sbcglobal.net

Mr. Pete Geren, President, Sid W. Richardson Foundation
309 Main Street, Fort Worth, Texas 76102-4088
pgeren@sidrichardson.org
817.336.0494
www.sidrichardson.org

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The project would not have been possible without the efforts of CREATE, Center for Research, Evaluation and Advancement of Teacher Education, which provided expert management and oversight of the overall venture. To this end, we acknowledge the leadership and support provided by Mona Wineburg, Executive Director, as well as Sherri Lowrey and Jeanette Narvaez, Associate Directors of the organization.

We also express our gratitude to Manda Rosser, Associate Professor at Texas A&M University, and her research team there for their work in the initial research design, sample selection, instrument development, and first-year data collection. Likewise, we are indebted to Jo Ann Wheeler and David Eschberger of Region 4 Education Service Center and their entire research team for data collection in the second and third years, as well as their in-depth analysis and reporting of the findings for all three years.

For this extended analysis and fifth-year follow-up report, we have benefitted from the exceptional work of Linda Reaves and Joe Crane of TCES & Associates. They have done a splendid job of extending our views into the continuing professional experiences of these classroom teachers and have successfully summarized the major learning points of this entire endeavor. We also acknowledge the many contributions of Bill and Pam Lawrence of Lawrence & Associates in editing, producing, and disseminating this final report and those of Susan Cook in designing the report.

We are, however, especially indebted to the 51 Texas teachers who were the active Forum participants in this examination. We thank each of them for their willingness to share their professional experiences, including their candid assessments of the struggles and successes of today's high school math and science instructors, for the purposes of improving opportunities for future generations of science and math teachers in our state. We are grateful to each of these teachers for the time each has given us over the past five years. It has been our pleasure to get to know them, and through our work with them, we have come to see that Texas schools and the students whom they teach are well served by their daily efforts in their high school classrooms.

Executive Summary

High school science and math are two teaching fields that have persisted among the most critical shortage areas facing Texas schools. Given the demographic trends extant within the state, the Sid W. Richardson Foundation Forum leaders recognize that unless and until teacher supply and related retention issues are satisfactorily addressed, Texas will continue to experience long-term shortages of highly qualified science and math teachers within its high schools.

In 2005, the Forum undertook an investigation of beginning math and science teachers in Texas high schools in an effort to gain greater insight into the problem. The Forum sought to (1) affirm retention and attrition patterns of high school math and science teachers in Texas, (2) examine the factors that motivated teachers to enter and stay in these critical teaching fields, and (3) learn more about the professional perspectives and experiences of new science and math teachers as they entered their assignments in Texas high schools. The Forum engaged practicing teachers directly in the investigation to learn more about these issues from the firsthand perspectives and experiences of high school teachers themselves.

51 Math and Science Teachers in Texas is a longitudinal study of teachers who began their careers in Texas high schools in the fall of 2005. They were employed by 36 high schools located in four of the fastest-growing sectors of the state—Dallas-Fort Worth, Greater Houston, San Antonio-Austin, and South Texas-Rio Grande Valley. The average enrollment of these Texas high schools exceeded 1,900 students, with over 54% of the students classified as economically disadvantaged. Approximately 60% of teachers participating in the study were math certified, second career, alternatively prepared, and female; the other 40% were science certified, first career, traditionally prepared, and male.

Over the five years of the study, researchers examined professional preparation, classroom assignments, and retention and attrition patterns of participating teachers. In addition they conducted numerous surveys, interviews and focus groups with the teacher cohort to ascertain their viewpoints and professional experiences as they moved successively through their initial years of teaching. Major findings and implications for action are summarized below.

Findings Related to Retention and Attrition

At the conclusion of five years, 75% of the subject teachers remained active in the education profession, with 57% remaining in secondary math or science classrooms. These retention and attrition patterns of the cohort teachers were generally consistent with those of secondary math and science teachers statewide.

Findings and Implications Based on the Professional Experiences and Perspectives of High School Math and Science Teachers

The professional experiences and perspectives reported by the teachers involved in the study suggest that improvements may be achieved in three major areas in order to increase supply and enhance retention of high school science and math teachers:

1. Promote earlier identification and active recruitment of talented teaching prospects to increase the supply of first-career educators in Texas high school classrooms.
2. Improve the quality of secondary teacher preparation programs.
3. Improve professional support and working conditions in Texas high schools for first-year teachers.

The findings of the study suggest that early recruiting and expanded college pathways to better facilitate teacher prospects to pursue teaching as their first career could increase job satisfaction and teacher retention. First-career teachers in the study tended to stay longer, both in the classroom and within the profession, and

they also reported greater satisfaction with colleagues and administrators. The factors that teachers reported as motivators to pursue teaching, as well as affecting their time frame for making their career decisions, provide insights to strengthen university teacher recruitment initiatives. The career decision experiences reported by these teachers suggest a potential pool of young, academically talented teachers formulating career and related college preparation decisions as early as high school.

Teachers in the study offered a number of suggestions to strengthen the curriculum and effectiveness of secondary teacher preparation programs, whether alternative or university-based programs. They reported that they would have benefitted from more pre-service instruction in quality teacher preparation programs. The experiences and perspectives of the teachers in this study suggest that leaders of preparation programs, both alternative and traditional, should re-examine the practical focus and depth of learning provided in present secondary teacher preparation programs related to areas such as classroom management and discipline techniques, pedagogical and curricular content knowledge in science and math; structured field observations of high school science and math classes, as well as guided practice opportunities. Serious efforts to expand and refine instruct content in these areas in university- based teacher preparation programs are likely to face challenges under present state policy regulations that restrict the number of required course hours for educator preparation programs.

The first-year challenges reported by teachers through interviews and focus group activities also imply that greater efforts must be made by school districts to accommodate the unique needs of novice teachers. The findings suggest that principals, math/science department heads, and team leaders in Texas high schools should adapt their scheduling practices and teacher assignment norms to allow new teachers greater opportunities for on-the-job professional development opportunities, more instructional planning and preparation time, and easier access to professional mentors and colleagues.

Implications for Action

1. Increase the supply of first-career teachers.

(a) Develop recruitment in high school.

- Just as universities pursue gifted athletes, it would seem that science and math classes in area high schools might serve as fertile recruiting grounds for science and math teacher prospects.
- The significance that high school teachers reportedly played in the decisions of many of these teachers to pursue their particular fields suggests that approaches that enable current high school teachers to systematically nominate prime candidates for university teacher preparation programs could prove to be useful recruitment strategies.

(b) Expand recruitment efforts in college. The findings regarding the timing of career decisions in early college years also reinforce the growing practice of recruiting for math and science teacher candidates among entering freshmen in university colleges of arts and sciences—an approach made popular by the success of the UTeach Program at The University of Texas at Austin.

2. Improve the quality of secondary math and science teacher preparation programs.

(a) Emphasize pedagogical and curricular knowledge that specifically addresses:

- Deep understanding of the state curriculum and assessment standards and their relationship to the scope, sequence, and pacing of high school math and science course content;
- Instructional tools and graphic organizers to convey and demonstrate key content objects in a clear, interesting, and coherent manner;
- Classroom activities and strategies to actively engage students and motivate them to participate in the learning;

- Practical strategies for classroom management and student disciplinary techniques in high school classrooms;
- Instructional modifications and adaptations for students with special needs, both special education and limited-English proficient;
- Homework and outside-of-class projects to reinforce and extend classroom instruction; and
- Classroom assessments to determine student understanding and mastery of the content.

b) Provide field observation and guided practice teaching consisting of multiple opportunities to:

- Observe master teachers of math and science teaching high school students;
- Analyze their observations relative to the key components of pedagogical and curricular knowledge; and
- Apply what they learned in practice teaching situations.

3. Improve the quality of district/campus support for first-year teachers.

(a) Refrain from assigning first-year teachers the most challenging students.

(b) Limit the number of preparations assigned to new teachers.

(c) Ensure that the mentors of first-year teachers are masters in their content as well as in classroom and student behavior management.

(d) Consider a unique planning schedule for first-year teachers that might include:

- A common conference period with the mentor teacher, ideally at the end of the day to debrief and finalize lesson plans for the following day, and
- An extra preparation period specifically to observe the mentor teach the planned lesson, preferably at the beginning of the day so the new teacher can see the lesson in action prior to teaching it for the first time.

(e) Before the first day of instruction, see that new teachers receive specific district and campus guidelines for the content of their courses, particularly as the sequencing and pacing of course objectives relate to end-of-year assessments.

(f) Schedule routine opportunities for new teachers to visit with and learn from campus administrators with regard to student discipline and related behavior and classroom management issues.

(g) Develop and support teacher learning communities that will afford new teachers opportunities to interact with and learn from experienced colleagues in the field.

The findings and implications of *51 Math and Science Teachers in Texas* flow from the experiences and perspectives of Texas high school teachers. This study has helped us better understand the practical aspects of the challenges that confront classroom teachers as they begin careers in Texas high schools by affording them an opportunity to voice their views and concerns. In order to address statewide shortages of math and science teachers in Texas high schools, it is imperative that we heed their voices. Their issues merit attention and concerted action by education and policy leaders in Texas.

Section 1: Background and Introduction

In 2005, the Sid W. Richardson Foundation commissioned a field study of math and science teachers in Texas high schools. The study was inaugurated in conjunction with efforts of the Sid W. Richardson Forum to examine university-based teacher preparation within the state, especially those programs addressing math and science teachers, and to offer recommendations for improving their effectiveness and productivity. At the time, the state had enacted policies that increased high school graduation requirements in math and science, and the State Board for Educator Certification had declared critical shortages of qualified teachers in both of these teaching fields. In addition to exploring mechanisms for enhancing teacher production at Texas universities, there was also a need to consider school support factors that contribute to the attrition of math and science teachers in Texas schools, as research reports available to the Foundation at that time indicated that 30% to 42% of the science and math teachers in Texas high schools left the profession during their first three years.

In the course of examining professional literature related to these matters, reviewers were affected by the writings of two prominent scholars on the subject—Lee Shulman, the distinguished educational researcher and former President of the Carnegie Foundation for the Advancement of Teaching, and Susan Moore Johnson, professor and former Dean of Harvard's Graduate School of Education.

In *The Wisdom of Practice,* Suzanne Wilson's beautifully edited compendium of essays by Shulman on teaching and learning to teach (Wilson, 2004), reviewers were drawn to Shulman's deep focus on the intellectual preparation and development of teachers, by his legitimization of the specialized professional knowledge of teachers attained only through authentic practice and reflection (the wisdom of practice), and his thoughtful delineation of the types of content knowledge necessary for teachers to function effectively over time (beyond mere recall of facts). The reviewers were struck by Shulman's emphasis on collaborative studies that actively engage teachers as a means of integrating their distinct "teacher voice" into truly meaningful research, thereby authenticating the discourse on policy and classroom practice.

Reviewers also examined research conducted by Professor Susan Moore Johnson and the Harvard University Project for the New Generation of Teachers. In their 2004 publication, *Finders* and *Keepers*, Dr. Johnson and her colleagues reported the findings of their in-depth exploration of career-launch experiences of 50 Massachusetts teachers, having closely followed this group of novice educators over the course of a two-year period. Their project was undertaken in an effort to identify factors that motivated these new teachers to enter and to stay in Massachusetts public schools. The Forum found their approach compelling and their findings instructive, and they wondered about a comparable examination of the viewpoints and experiences of beginning math and science teachers in Texas high schools. It was concluded that a similar qualitative study of the perspectives of math and science teachers in Texas would complement the Foundation's ongoing examinations of teacher recruitment and retention and perhaps contribute to the work of other stakeholders in the state in their efforts to better prepare and support science and math teachers. Thus, the study, *51 Math and Science Teachers in Texas,* was born.

The Foundation awarded a grant to the Center for Research, Evaluation, and Advancement of Teacher Education (CREATE) to facilitate and manage the study. CREATE, in turn, contracted with researchers at Texas A&M University to develop a Texas-based design replicating appropriate aspects of the Harvard initiative. After initial design and first-year data collection, responsibilities for the study were transferred to Region 4 Education Service Center (Region 4), and the remaining work was completed by a math/science project team headed by Jo Ann Wheeler and David Eschberger.

Overview of the Initial Study Design and Description of the Sample

As the title implies, the study monitored the viewpoints and experiences of 51beginning math and science teachers launching their teaching careers in Texas high schools during the 2005–2006 academic year. The investigation sought to address six primary questions:

1. What were the retention and attrition patterns for this cohort of science and math teachers over a three-year period?
2. What attracted these individuals to become high school math or science teachers in the first place?
3. How did their initial teacher preparation experiences prepare them for their careers as teachers?
4. What on-the-job challenges did they encounter during their beginning years in teaching math and science?
5. What contributed to their success in overcoming these initial challenges?
6. What has motivated these teachers to remain in or leave the profession?

Teacher participants for the study were randomly selected from the new-employee rosters of 12 school districts. Participating districts were purposely selected to ensure appropriate socioeconomic representation within four of the fastest-growing sectors of the state:

- Dallas-Fort Worth Metroplex (4 districts)
- Greater Houston Area (4 districts)
- San Antonio-Austin Corridor (1 district)
- South Texas-Rio Grande Valley (3 districts)

The 51 teachers selected for the study were assigned by their respective districts to 36 high school campuses. Table 1 provides a summary of the campus enrollments and socioeconomic characteristics of these high schools during the 2005–2006 school year (Texas Education Agency, Academic Excellence Indicator System 2005–2006 Campus Profile, fall 2006).

Table 1. Campus Demographics

2005–2006 Campus Demographics	High Schools	Campus Enrollment		Economically Disadvantaged		Teachers in Study
		Range	Mean	Range	Mean	
Dallas-Fort Worth	19	998–4,596	1,984	19%–78%	56.5%	26
Houston	10	846–2,793	1,634	25%–80%	56.2%	13
San Antonio-Austin	4	1,987–2,789	2,363	26%–67%	42.9%	7
South Texas-Valley	3	1,253–2,580	1,992	31%–67%	52.5%	5
Overall	**36**	**846–4,596**	**1,937**	**19%–80%**	**54.4%**	**51**

Just over half (19) of the 36 campuses were located in the Dallas-Fort Worth Metroplex; likewise, slightly over half of the teachers in the sample were employed by campuses in that area.

Of these 36 high school campuses, two were alternative schools with student enrollments that varied throughout the year. Among the 34 regular high schools, student enrollment ranged from a low of 846 to high of 4,596, with an average enrollment of 1,937 students per campus. The percentage of students classified as economically disadvantaged in the schools ranged from 19% to 80%, with an average of 54.4%.

Table 2 summarizes the initial placement of the 51 teachers by the percent of students classified as economically disadvantaged on their employing campuses.

Table 2. Teacher Employment by Campus % Economically Disadvantaged

Campus Economically Disadvantaged, 2005–2006	0%–25%	25%–50%	**0%–50%**	50%–75%	75%–100%	**50%–100%**
Teachers Employed (n)	2	17	**19**	28	4	**32**
% of 51	4%	33%	**37%**	55%	8%	**63%**

Of the teachers, 37% (19 of 51) were initially employed on high school campuses reporting less than 50% of the students as economically disadvantaged, including two teachers on campuses with 25% or less classified as economically disadvantaged.

The other 63% (32 of 51) were initially employed on high school campuses reporting greater than 50% of the students as economically disadvantaged; of these, four teachers began on campuses with 75% to 100% classified as economically disadvantaged.

Table 3 describes the demographic characteristics of the 51 teachers engaged in the study.

Table 3. Teacher Demographics

Teacher Demographics 2005–2006	Gender		Career		Preparation		Certification	
	Female	Male	1st	2nd up	Alternative	Traditional	Math	Science
Teachers (n)	32	19	22	29	30	21	28	23
% of 51	63%	37%	43%	57%	59%	41%	55%	45%

Of the 51 teachers randomly selected to participate in the study:

- 63% were female vs. 37% male;
- 43% were beginning a first career vs. 57% beginning a second career;
- 59% were alternatively prepared vs. 41% traditionally prepared; and
- 55% were math certified vs. 45% science certified.

Investigators followed these 51 teachers over three academic years (2005–2006, 2006–2007, and 2007–2008), documenting their attitudes, opinions, and experiences through a series of interviews, questionnaires, and focus group activities. The Region 4 team completed its analysis in August 2008 and submitted a final report to CREATE and to the Foundation, written by Jo Ann Wheeler and David Eschberger and titled *50 Texas Mathematics and Science Teachers: Year 3 (2007–2008) Report.* (Note: The study originally had 50 teachers, hence the name. During the first year, however, a teacher was added to the cohort, changing the actual total to 51; nevertheless, the authors kept the original title of the study.)

The Follow-Up Investigation

After completing the Forum report on university-based teacher preparation in 2009, the Foundation decided to follow up on the three-year study of math and science teachers in Texas (Wheeler & Eschberger, 2008) to assess the continued professional experiences of those teachers. In the follow-up study, the Foundation sought to determine whether these cohort teachers remained in the classroom after five years and, if so, to solicit their "more seasoned" reflections on their experiences.

The Foundation commissioned the consulting firm, TCES & Associates, to locate as many of the original 51 teachers as possible to examine their retention and attrition patterns and to conduct individual interviews regarding their professional experiences and assessments of their first five years of teaching. The consultants also facilitated a series of focus-group sessions to glean teacher perspectives as a group.

The follow-up study accounted for the employment status of each of the 51 cohort members at the end of:

- Year 1 and Year 3 by using data collected in the original three-year study.
- Year 5 by using:

  (a) the state Public Education Information Management System (PEIMS) employment database and, for those not found in PEIMS,

  (b) firsthand contact/communication or

  (c) data from the original three-year study.

A summary of employment at the end of Year 5 as determined by data source is displayed in Table 4.

Table 4. Employment in Year 5 by Data Source

Year 5 Employment Status	PEIMS	Follow-Up Study Contact	Original Study Data	Total
High School (HS) math/science classroom teacher	28	1 (HS in Kansas)		29
Within K-12 profession (HS social studies, Jr. HS math/science, homebound, 2nd grade, diagnostician)	9			9
Within education (university training program, math consultant, tutorial company)		4		4
Left the education profession		5	4 (interview records)	9
Total	37	10	4	**51**

At the end of Year 5, the results of the search for the original 51 teachers revealed that:

- 29 were employed as high school math or science teachers,
- 38 (29+9) were employed within the K-12 profession,
- 42 (29+9+4) were employed within either the K-12 profession or a for-profit education entity, and
- 9 had left the public education profession in Texas.

A total of 21 members of the cohort consented to participate in interviews or focus groups for the follow-up study. Among the 21 who participated in the follow-up study were three of the nine who had left education.

As teacher attrition rates continued to be a topic of concern in the professional literature during the course of the initial study, a major objective of the follow-up investigation was to verify whether attrition for the *51 Math and Science Teachers in Texas* cohort varied from those of the statewide teacher population. In the interest of benchmarking the retention and attrition patterns of the cohort against those of statewide teachers in the field, data on first-, third-, and fifth-year retention and attrition of the 51 teachers were considered in two ways.

First, an analysis of the percentage of the teachers continuing to teach science and math in Texas high schools was conducted. The patterns of this study cohort were compared to statewide trends reported by Fuller in his 2008 study on the supply and demand of math and science teachers on behalf of Texas Instruments Corporation and the Texas Business Education Coalition. This analysis revealed the "classroom staying power" of the 51 cohort teachers in relation to their peers across Texas. The analysis determined that the attrition/retention rates of the 51 cohort teachers were similar to those of their statewide counterparts. Given that their patterns parallel those of the state at large, the qualitative perspectives gleaned from interviews with these teachers during the initial and follow-up studies take on renewed importance, as they offer insight into factors that may contribute to teacher decisions to stay (or leave) science and math classrooms in Texas.

A second analysis, unique to the follow-up study, dealt with teacher retention within the profession. This analysis was inspired by a working philosophy of the Teach for America (TFA) program. TFA is a prominent alternative teacher education program that places teaching candidates in high-need classroom assignments for a period of two years. While this two-year teaching paradigm results in relatively high turnover rates in TFA classrooms, an offsetting benefit to such short-term classroom assignments espoused by the organization is that many alumni of the program continue to work in other leadership capacities within the education profession. The investigators felt that there was merit to the view that talented and experienced teachers can continue to make meaningful contributions in a broad range of professional roles; thus, they sought to consider the long-term professional retention patterns of the teachers within this study.

Purpose and Limitations of This Report

This report summarizes the major findings of the longitudinal study of 51 math and science teachers in Texas. It provides a synthesis of the learning points from both the third-year report issued by Region 4 and the fifth-year follow-up conducted by TCES & Associates. The findings of these studies are synthesized in two sections: the first provides a quantitative analysis of the retention and attrition patterns for this cohort of math and science teachers, and the second provides a qualitative assessment of the experiences and factors that contributed to the decisions of these teachers to either stay in or leave their schools and/or the profession. A final section provides conclusions and implications observed by the researchers.

Given the qualitative nature of the design and the sampling limitations of the investigations, the findings may not be construed as absolutely definitive. Nonetheless, they provide significant insight into the development, support, and work circumstances of new high school math and science teachers in Texas.

The *51 Math and Science Teachers in Texas* project has offered the Foundation a unique opportunity to view the work of teaching science and math in today's schools through the eyes of high school teachers, yielding a professional perspective that has enriched the Foundation's views on the quality and effectiveness of the teacher workforce in Texas schools. Taken in conjunction with other professional initiatives of the Foundation, much has been learned from observations and dialogue with these teachers. These studies reinforce the professional learning gleaned by the Sid W. Richardson Foundation from other Forum

discussions. The work with these 51 Texas teachers has exposed the Foundation Forum to "on-the-ground" issues of high school teachers and has provided practical cases that are representative of the many dedicated educators who teach in our state's high schools. What follows is a synopsis of what has been learned from our dialogue and engagement with these teachers.

Section 2: Retention and Attrition Patterns

During their first year, each of the 51 teachers taught either math or science on a high school campus. In subsequent years, however, some stayed on the same campus or moved to a different high school campus; others changed grade levels or subjects within the profession while yet others left the profession to pursue careers in business or industry or left in favor of other priorities. This study analyzed patterns of retention and attrition over time for two groups of cohort teachers.

- One group was comprised of only those members of the cohort who continued teaching high school math or science—either on their initial campuses of employment or on different high school campuses.
- The other group consisted of those who remained in the K-12 profession—either continuing to teach high school math/science, moving to a different grade level, or changing to another subject or to a job role other than teacher.

These patterns for the cohort group were then compared to the findings of large-scale studies on teacher retention and attrition in Texas (Fuller, 2006, 2008) and nationally (Johnson 2005, 2006) in order to establish the degree to which the relatively small cohort of 51 teachers was representative of secondary math and science teachers in general.

The most significant contribution of the *51 Math and Science Teachers in Texas* study lies in its qualitative findings, which are based on the perspectives and experiences of the cohort—from the time they first considered teaching as a profession, during their first year as high school math and science teachers, and through a period of five years thereafter. A primary purpose of this quantitative analysis of cohort retention and attrition patterns presented in this section was to establish validity of the cohort teacher "voices" reported herein.

Retention in High School Math and Science Classrooms

Retention and attrition patterns related to high school math/science through Year 1, Year 3, and Year 5 were analyzed for the study cohort overall as well as:

- By campus poverty, with low-poverty campuses having 0% to 50% of the students economically disadvantaged and high-poverty campuses having 50% to 100% of the students economically disadvantaged,
- For teacher turnover or change from original campus of employment, and
- Relative to gender (female vs. male), career (first vs. second), preparation (alternative vs. traditional), and certification (math vs. science).

Overall patterns for high school. Table 5 presents cohort retention overall through Year 1, Year 3, and Year 5.

Table 5. Retention in High School Math/Science—Overall

Retention Number (n) Rate (% of 51)	Entered Aug. 2005		Year 1 (2005–2006)		Year 3 (2007–2008)		Year 5 (2009–2010)	
	n	% of 51	n	% of 51	n	% of 51	n	% of 51
Overall	51	100%	43	84%	39	76%	29	57%

The overall retention rates in high school math and science classrooms for the teachers in this study were:

- 84% (43 of 51) after the first year,
- 76% (39 of 51) through the third year, and
- 57% (29 of 51) through the fifth year, which ended in May 2010.

The overall attrition rates for those study cohort teachers who left their high school math/ science classrooms were:

- 16% (8 of 51) after the first year,
- 24% (12 of 51) through the third year, and
- 43% (22 of 51) through the fifth year.

In his analysis of secondary math and science teachers in Texas, Fuller (2008) found that about 25% left their classroom assignments after three years and about 33% left after five years. The three-year attrition rate of 24% for this cohort of 51 teachers was very much in keeping with Fuller's findings for the statewide sample of teachers; however, the five-year attrition rate of 43% for the cohort teachers was greater than the 33% found for the statewide sample.

High school retention related to poverty. Retention of teachers in high school math and science classrooms was further analyzed by campus poverty. Low-poverty campuses were those with 0% to 50% of the student body classified as economically disadvantaged; their retention rates were calculated separately from the rates for high-poverty campuses with 50% to 100% of the student body classified as economically disadvantaged. For teachers who moved to different high school campuses, the percent of disadvantaged students on the new campuses was used.

Retention rates for low- and high-poverty campuses are displayed in Table 6.

Table 6. Retention in High School Math/Science—By Campus % Economically Disadvantaged

	Entered Aug. 2005			Year 1 (2005–2006)		Year 3 (2007–2008)		Year 5 (2009–2010)	
Campus Poverty	n	% of 51	% of n	# ret.	% of n	# ret.	% of n	# ret.	% of n
Low (0% to 50%)	19	37%	100%	16	84%	22	116%	14	74%
High (50% to 100%)	32	63%	100%	27	84%	17	53%	15	47%

In August 2005, 37% of the teachers were employed by low-poverty campuses and 63% were employed by high-poverty campuses. In subsequent years, retention on low-poverty campuses changed from 100% (19 of 19) at the beginning of Year 1 to:

- 84% (16 of 19) after Year 1,
- 116% (22 of 19) through year 3 (the composite of teachers who stayed at their original, low-poverty schools plus those who moved from high-poverty campuses), and
- 74% (14 of 19) through Year 5.

Over the five-year period, retention on high-poverty campuses changed from 100% (32 of 32) at the beginning of year 1 to:

- 84% (27 of 32) after Year 1,
- 53% (17 of 32) through Year 3, and
- 47% (15 of 32) through Year 5.

At the end of Year 5, retention on low- vs. high-poverty campuses was 74% vs. 47%, respectively. For this cohort, retention rates over time on high-poverty campuses were substantially less than those on low-poverty campuses. This trend of teachers migrating from high-poverty to low-poverty campuses is consistent with findings from other studies done in Texas (Fuller 2006, 2008) and nationwide patterns reported by Johnson (2005, 2006).

High school teacher turnover. The extent to which cohort teachers remained at their original high school over time was also examined in terms of teacher turnover rates overall and as a function of campus poverty. This examination used Fuller's (2006, 2008) definition of teacher turnover: the sum of teachers who changed campuses plus those who left teaching—that is, all cohort teachers who left their original campus of employment for any reason.

Table 7 summarizes cohort teacher turnover overall and by campus percent economically disadvantaged.

Table 7. Teacher Turnover—Overall and by Campus % Economically Disadvantaged

	Entered Aug. 2005		Year 1 (2005–2006)		Year 3 (2007–2008)		Year 5 (2009–2010)	
Campus Poverty	n	% of 51	# turn.	% of n	# turn.	% of n	# turn.	% of n
Low (0% to 50%)	19	31%	4	21%	6	32%	14	74%
High (50% to 100%)	32	53%	7	22%	18	56%	23	72%
Overall	**51**	**100%**	**11**	**22%**	**24**	**47%**	**37**	**73%**

Overall turnover rates for the cohort of 51 math and science teachers were:

- 22% after Year 1,
- 47% through Year 3, and
- 73% through Year 5.

Turnover rates for the 19 teachers who were employed by low-poverty high schools were:

- 21% after Year 1,
- 32% through Year 3, and
- 74% through Year 5.

Turnover rates for the 32 teachers who were employed by high-poverty high schools were:

- 22% after Year 1,
- 56% through Year 3, and
- 72% through Year 5.

A longitudinal comparison of turnover rates for cohort teachers originally employed in low- and high-poverty high schools were:

- About the same after year 1 (21% and 22%, respectively),
- Less for low- than for high-poverty schools after year 3 (32% and 56%, respectively), and
- About the same after Year 5 (74% and 72%, respectively).

In his 2008 study, Fuller examined turnover rates for only one year. He found the one-year turnover rate for high schools to be about 23% overall with somewhat less turnover for low-poverty schools (20% to 21%) and somewhat greater turnover for high-poverty schools (24% to 25%). Findings on the first-year turnover rates for this cohort of 51 teachers were consistent with his report on statewide trends.

Demographics of teachers remaining in high school. Retention by teacher demographics for those who continued to teach high school math or science through May 2010 (Year 5) is displayed in Table 8.

Table 8. Retention in High School Math/Science—By Teacher Demographics

	Gender		Career		Preparation		Certification	
	Female	Male	1st	2nd up	Alternative	Traditional	Math	Science
# Begin Year 1	32	19	22	29	30	21	28	23
# End Year 5	17	12	16	13	17	12	13	16
% Remaining	53%	63%	73%	45%	57%	57%	46%	70%

The highest retention rates in high school math/science through Year 5 were for teachers who were:

- First career with 73% (16 of 22) remaining and
- Science certified with 70% (16 of 23) remaining.

The lowest retention rates were for teachers who were:

- Second career with only 45% (13 of 29) remaining and
- Math certified with only 46% (13 of 28) continuing.

Alternatively vs. traditionally prepared teachers remained in high school math/science at the same rate—57% for both. Males continued teaching high school math and science at a higher rate than did females, 63% vs. 53%, respectively.

These rates were inconsistent with Fuller (2006, 2008), who found that retention rates tended to be: (a) about the same for math- vs. science-certified teachers and (b) higher for traditionally vs. alternatively prepared teachers. However, when the cohort teachers who moved to junior high—all of which were math certified—were included, the retention rates of math- and science-certified teachers became more similar. A summary of these data follows.

Retention in the Profession

In addition to those who continued to teach high school math and science, nine of the 51 remained in the profession but moved to other K-12 grade levels, subjects, or job roles. Of the nine remaining in the profession, five moved to junior high math/science and one each to homebound math/science, high school social studies, elementary teacher, and diagnostician. First-, third-, and fifth-year patterns of retention and attrition for cohort teachers who remained in the K-12 profession were analyzed overall as well as:

- By campus or district percent poverty, with low-poverty campuses/districts having 0% to 50% of the students economically disadvantaged and high-poverty campuses/districts having 50% to 100% of the students economically disadvantaged, and
- Relative to the change in the demographics of gender (female vs. male), career (first vs. second), preparation (alternative vs. traditional), and certification (math vs. science).

Overall patterns for the K-12 profession. Cohort retention and attrition within the K-12 profession over time is displayed in Table 9.

Table 9. Retention in the Profession—Overall

Retention Number (n) Rate (% of 51)	Entered Aug. 2005		Year 1 (2005–2006)		Year 3 (2007–2008)		Year 5 (2009–2010)	
	n	% of 51	n	% of 51	n	% of 51	n	% of 51
Overall	51	100%	48	94%	46	90%	38	75%

Overall retention rates in the K-12 profession for the study cohort of 51 teachers who entered the profession in August 2005 were:

- 94% (48 of 51) after the first year,
- 90% (46 of 51) through the third year, and
- 75% (38 of 51) through the fifth year, which ended in May 2010.

This means that 90% of the cohort teachers were continuing to provide leadership to public education after three years and that 75% remained active as education professionals after five years. Furthermore, not all of those who left their entry job as high school math/science teachers were lost to the classroom; indeed, six of the nine continued to teach math or science either at junior high or to homebound students. Combining these six "movers" with the teachers who stayed in high school created a new sub-set of secondary—high school and junior high—math/science teachers with three- and five-year classroom retention rates of 84% and 69%, respectively.

The attrition rates for cohort teachers who continued teaching secondary math/science (in classrooms at either high school or junior high) was 16% and 31% after three and five years, respectively. Relative to statewide rates reported by Fuller (2008), the three-year rate for the cohort is less than the statewide rate of 25% and the five-year rate is about the same as the statewide rate of 33%.

Campus and district retention related to poverty. Table 10 summarizes retention in the K-12 profession by district or campus poverty.

Table 10. Retention in the Profession—By Campus % Economically Disadvantaged

Campus or District Poverty	Entered Aug. 2005			Year 1 (2005–2006)		Year 3 (2007–2008)		Year 5 (2009–2010)	
	n	% of 51	% of n	# ret.	% of n	# ret.	% of n	# ret.	% of n
Low (0% to 50%)	19	37%	100%	19	100%	25	132%	19	100%
High (50% to 100%)	32	63%	100%	29	91%	21	66%	19	59%

In August 2005, 37% of the cohort teachers were employed on low-poverty campuses, and 63% were employed on high-poverty campuses.

In subsequent years, retention by low-poverty campuses or districts:

- Remained at 100% (19 of 19) at the end of Year 1,
- Increased to 132% (25 of 19) after Year 3, and
- Ended Year 5 at 100% with the same number of teachers (19) that began Year 1.

Over the same five-year period, retention by high-poverty campuses or districts:

- Decreased to 91% (29 of 32) after Year 1,
- Decreased to 66% (21 of 32) after Year 3, and
- Ended Year 5 at 59% with 19 of the 32 teachers that began Year 1.

At the end of Year 5, retention by low- vs. high-poverty campuses/districts was 100% vs. 59%, respectively. For this cohort, retention rates for high-poverty campuses or districts were substantially less than those for low-poverty campuses or districts. In terms of direction and magnitude, this finding on retention by low- vs. high-poverty campuses or districts is consistent with the body of research on retention related to school poverty.

Demographics of teachers remaining in the profession. Retention by teacher demographics for those who remained in the profession through May 2010 (Year 5) is displayed in Table 11.

Table 11. Retention in the Profession—Change in Teacher Demographics

	Gender		Career		Preparation		Certification	
	Female	Male	1st	2nd up	Alternative	Traditional	Math	Science
# Begin Year 1	32	19	22	29	30	21	28	23
# End Year 5	23	25	19	19	21	17	20	18
% Remaining	72%	79%	86%	66%	70%	81%	71%	78%

The highest retention rates in the profession through Year 5 were for teachers who were:

- First career with 86% (19 of 22) remaining and
- Traditionally prepared with 81% (17 of 21) remaining.

The lowest retention rate was for those teachers who were:

- Second career with only 66% remaining and
- Alternatively prepared with 70% remaining.

Males remained in the profession at a higher rate than did females. Likewise, science-certified teachers remained at a higher rate than did math-certified teachers.

Change Within the Profession and Attrition

Over the five-year period, a total of 9 of the original cohort of 51 teachers moved to other grade levels, subjects, or job roles within the K-12 profession. Of the 9:

- 7 were certified in math; 2 were certified in science
- 6 had at least one other career prior to entering teaching; 3 were in their first career
- 6 were female; 3 were male
- 5 were prepared in a traditional program; 4 received their preparation in an alternative certification program

Most of the teachers who moved within the profession were math certified, second career, female, and traditionally prepared.

Information on the professional job changes of the 9 teachers who moved within the profession is summarized below.

- 5 moved to middle/junior high school as math or science teachers; of these, 1 was transferred by the district, at least 1 other was the result of a family move to another part of the state, and at least 2 others were because the "campus was closer to home";
- 1 became a district-wide homebound teacher of secondary math and science;
- 1 changed to social studies in order to remain in a coaching position;
- 1 took a position as a diagnostician; and
- 1 moved to an elementary campus as a second- grade teacher.

Of the nine teachers who moved within the profession, six continued to teach math or science at the secondary level, either at junior high or to homebound students. All six were math certified.

A total of 13 teachers left the profession entirely between the end of Year 1 (May 2006) and the beginning of Year 5 (August 2009). Of the 13 who left:

- 10 had at least one other career prior to entering teaching, and 3 were in their first career;
- 9 were female, and 4 were male;
- 9 received their preparation in an alternative certification program, and 4 were prepared in a traditional program;
- 8 were certified in math, and 5 were certified in science.

Most of the teachers who left the profession were second career, female, alternatively prepared, and math certified. Information on why they left is summarized below.

- 3 chose to stay home with children;
- 3 took jobs in for-profit education services: 1 started a consulting business to prepare students for TAKS, and 2 were employed by a tutorial software company to provide teacher support and training;
- 2 moved to positions as training specialists/coordinators within the energy industry: 1 to an oil equipment manufacturing company and 1 to nuclear power generation;
- 2 did not provide specific reason(s); however, 1 was retired from industry and the other had worked in business and held an advanced degree in business management;
- 1 was overwhelmed with the hopelessness of the future for most students;
- 1 only confirmed that s/he was no longer teaching; and
- 1 has remained unaccounted for.

Of the 13 teachers who left the profession, at least seven either returned to retirement or moved to jobs within business and industry.

Summary of Patterns for Study Cohort vs. Statewide Teachers

Overall, the retention and attrition patterns of the cohort were found to be consistent with the findings of statewide studies of secondary math and science teachers. Consistencies were found in patterns for:

- High school math/science overall through Year 3, by campus poverty in direction and magnitude after Year 1 and through Years 3 and 5, and one-year turnover rates overall and by campus poverty; and
- Secondary (including junior high) math/science overall through Year 5, by campus poverty in direction and magnitude after Year 1 and through Years 3 and 5, and greater attrition for teachers alternatively prepared than for those traditionally prepared.

Differences between cohort and statewide patterns in the following areas were primarily (or at least possibly) due to the nature of the study.

- Three-year attrition for the cohort teachers remaining in secondary math/science was somewhat lower, possibly due to the support they provided each other during their first three years.
- Five-year attrition rates for the cohort remaining in high school math/science were somewhat higher; however, a substantial number of cohort teachers certified in math moved to junior high classrooms.
- While attrition for cohort teachers who were alternatively prepared was higher than for those traditionally prepared, it was not as high as attrition for those who were second career vs. first career. Rather than being an inconsistency, this difference between cohort and statewide findings was possibly due to the fact that the data on first vs. second career was not available for analysis statewide. If this study had not had access to cohort teacher data on first vs. second career, the highest and lowest attrition rates would have been for teachers alternatively and traditionally prepared, respectively.

With substantially more similarities than differences, the retention/attrition patterns of the cohort parallel those of secondary math/science teachers statewide. Given this parallel, it can be assumed that the teacher "voices" summarized in Section 3 of this report reasonably reflect those of secondary math and science teachers throughout Texas.

Section 3: Professional Perspectives

Individuals within the cohort of *51 Math and Science Teachers in Texas* arrived as beginning high school teachers from a variety of early education and/or work experiences and with differing reasons for considering teaching as a career. This section summarizes the experiences and perceptions of these 51 Texas teachers to address the study questions about:

- Factors influencing the decision to become a teacher, including the timing of career decisions and teaching as a first or second career;
- Strengths of teacher preparation programs and suggestions for improvement;
- On-the-job challenges in the first year and building the wisdom of practice;
- Support that helped overcome the challenges of the first year; and
- Factors influencing decisions to continue (or leave) the profession.

Motivation to Teach and Timing of Career Decisions

So what exactly are the prevailing forces behind the decision of an individual to teach science or math in Texas high schools today, and when is this career decision actually made? The answer is varied, but the data gleaned from teachers in this study suggested that certain combinations of interpersonal characteristics, career orientations, and adult mentors might influence the strength of this motivation.

Most of the teachers in this study reported entering the profession based on one or more of the core values that have driven professional educators for years—a strong desire to teach that was manifested by a passion for working with young people (50%), a desire to use one's lifework to make a meaningful difference for others (45%), and a passion for a particular discipline as well as a desire to share this passion with others (38%).

These academic and interpersonal orientations came into play early for those pursuing science and math teaching careers. For many, it appeared that a personal facility and love of their subject matter emerged early in their schooling. Almost all teachers in this study reported strong academic interest and success in their subject (especially math) during their high school and college years.

- *I always wanted to be a teacher—probably since fourth grade. I love math.*
- *I was a business major and had to take calculus. I loved the calculus class and hated business statistics, economics, accounting. I liked math. So, what to do? People suggested Math Education. I went that route at the beginning of my sophomore year.*
- *I had always known that I loved math and science. I understood them in high school and tutored classmates during and after school. I really thought I would go into things related to biology. I was looking at professions that dealt with biology and saw "Teacher."*

In addition to their personal affinity for the subject matter, most teachers reported reinforcing relationships with high school and/or undergraduate instructors in the field. Teachers in this study frequently related personal stories of being inspired in their individual quests by the teachers they had encountered (often teachers in lower grades), especially those who enabled them to enjoy and recognize their particular affinities for science and/or math content.

- *My fourth- and sixth-grade math teachers were very memorable for me.*
- *I have a special-needs daughter, and I saw how much difference her teachers made . . . They helped her grow a lot, especially in junior high. I wanted to be a teacher.*

Many recalled high school teachers or administrators who had actually suggested that they would make good teachers, planting the initial seed of encouragement for their consideration of teaching as a possible career choice.

- *I had a math teacher in junior high that directed me toward teaching math.*
- *I had a high school teacher tell me I should go into teaching. I just found all the classes I needed and got done as soon as possible.*
- *A teacher . . . had told my mom that I would be a good teacher.*

While many teachers reported having been positively influenced and encouraged by members of their family who were already in the teaching profession, several also reported instances of being dissuaded from the prospects of teaching by parents and family members in professions other than teaching, who encouraged pursuit of more lucrative and less stressful opportunities. Illustrative examples of both forms of family influence are found in the following stories relayed by participants.

- *I knew I was going to be a teacher when I was five. My parents, grandma, and aunts are all teachers, so it was always in the cards for me. I had great role models!*
- *I used to pretend that I was a teacher as a kid, and I was always a math teacher. When I was in high school, I didn't know what to major in and I just thought I would be a math teacher. But my dad sat down with me with the university catalogue and he convinced me to go into engineering, and that's what I studied and worked in and I loved it. Later I became a teacher, even though my Dad encouraged me to go into engineering, I ended up going back to teaching.*

Few teachers reported encouragement from university faculty to consider teaching as an avenue for their academic degree. Most described a general ambivalence toward teaching on the part of their university science and math faculty.

In addition to the teachers' early academic success in the sciences and/or mathematics, generally coupled with encouragement from parents and/or practicing professionals, the data suggested that interpersonal needs enter into students' decisions to consider teaching. These teachers reported that their consideration of teaching was also a result of their strong preferences to connect with and contribute meaningfully to the lives of others in the course of a career along with a related interest in positively influencing the lives of young people.

Teaching as a first or second career. While at least a cursory thought of teaching may have entered into their minds during high school or early in their undergraduate years (or even earlier for several), only 22 (43%) of the 51 math and science teachers in this study actualized this early interest by pursuing teaching as a first career. The remaining 29 study participants (57%) received undergraduate degrees in their respective disciplines and embarked on other career options, only to eventually migrate to the teaching profession. The timing and direction of their initial decisions to teach and whether they entered high school classrooms as first- or second-career teachers accounted for some of the most significant differences in how these teachers perceived the viability of their initial preparation, job satisfaction, and job stability.

Of the first-career teachers in this study, 89% made their decision to become a teacher either in high school or early in their undergraduate education. Some of these teachers had family or other role models in the profession who, as teachers themselves, encouraged and actively supported their entry into the field. Others changed their university major to education after learning that their original major either no longer held their interest or offered limited job opportunities. Although not exclusively, most first-career teachers attained their initial certification through traditional, university-based teacher preparation programs.

While some second-career teachers had considered teaching early on, most (75%) reported that they made the decision to teach only after working in another field or profession. These teachers moved from jobs in related fields such as chemical and mechanical engineering, health sciences, mechanical drafting, and law enforcement.

Most, but not all, of the second-career teachers received their initial training and certification via alternative teacher preparation programs.

Perceptions of Initial Preparation

Regardless of whether they received certification through conventional or alternative avenues, the science and math teachers included in this study acknowledged that their initial preparation experiences, while failing to render them as expert teachers on day one, offered practical value as they moved into their respective jobs in Texas high schools. Virtually all of them expressed views that their content courses taken in college were instrumental in their understanding of the instructional material they were responsible for presenting to students.

Beyond content preparation, however, there was less agreement with regard to the strength of pedagogical, curricular, and child development aspects of initial training experiences. These differences were most often dependent upon whether teachers were first- or second-career entrants and, therefore, whether they attained certification in a traditional or an alternative program.

Both traditionally and alternatively prepared teachers reported that their teacher preparation programs provided a sound foundation for:

- Writing lesson plans (94% and 88%, respectively) and
- Using effective instructional strategies (88% and 71%, respectively).

Traditionally prepared teachers reported more training opportunities than did their alternatively prepared counterparts to:

- Learn effective assessment practices (65% vs. 21%, respectively),
- Manage classroom materials and equipment (59% vs. 38%, respectively), and
- Assume complete classroom responsibilities (53% vs. 33%, respectively).

On the other hand, alternatively prepared teachers reported more training opportunities than did traditionally prepared teachers to learn to:

- Teach the Texas Essential Knowledge and Skills (50% vs. 29%, respectively),
- Work with students from diverse cultural backgrounds (46% vs. 35%, respectively),
- Teach TAKS-tested skills (38% vs. 12%, respectively), and
- Accommodate the realities of school culture (28% vs. 18%, respectively).

Overall, most teachers who went through conventional, university programs felt at least somewhat prepared in most pedagogical areas, with the exception of 33% who reported a lack of preparation in identifying instructional objectives and modifying for special needs of students. Conversely, a substantial proportion of the alternatively prepared teachers in the sample reported being unprepared to: modify for special-needs students (67%), effectively engage students in lessons (50%), manage student behavior (42%), and pace delivery of content (42%).

Teachers from both types of certification programs offered suggestions to improve their initial preparation programs. The suggestions focused on improvements in broad areas of teacher preparation that included:

- Opportunities to observe master teachers in science and mathematics teaching high school students,
- Practical discipline and classroom management techniques specific to high school students,
- Content-based teaching strategies (beyond lecture) to actively engage students,
- Instructional modifications and adaptations for diverse and reluctant learners, and
- Attention to TAKS-tested areas and related issues.

Building Wisdom of Practice—On-the-Job Learning in the First Year

While initial preparation experiences had value to these new science and math teachers, it was not surprising they reported that their most profound learning occurred while they were doing their job, especially during their first year in the classroom. No matter the mode of preliminary training, teachers agreed: *There is no substitute for actually being in charge of your own classroom.*

While conceptual learning related to the theory and mechanics of teaching delivered through initial preparation programs provided a general frame of reference for these new math and science teachers, real-time responsibilities for their own classroom required them to internalize these prior learnings. As Shulman suggests, real-time teaching and reflection thereon presents new teachers with opportunities to practice and perfect pedagogical and classroom management skills.

Despite the means of initial preparation, all teachers reported much to learn during their initial year on the job. The strength and complexity of this on-the-job learning reported by these new teachers was consistent with Shulman's observations on teacher knowledge development and makes perfect sense to anyone who has ever taught in a school environment. Experienced educators know exactly how daunting, yet critical, this initial year becomes. Despite this common knowledge, the significance of first-year learning for new teachers is often overlooked in local and state policy deliberations concerning new teacher development, professional support, and performance evaluation.

High schools are complex organizations and teaching is a complex job. It is worth digressing here to stress the scale of the tasks faced by first-year teachers as they report to their new assignments. In this regard, it may be helpful for readers to place themselves in the position of the 51 math and science teachers in August 2005 as each reported to work at one of the 36 high school campuses typical of those in fast-growing areas of Texas.

> *You report to your new school in early August, several weeks before classes begin. You are hopefully assigned a classroom at that time.* (Although, due to overcrowded schools, several of the teachers in this study did not have a classroom and had to "float" to a variety of different classrooms their first year). *You join a school faculty of over 100 teachers and you are one of over 15 teachers in your math or science department.*
>
> *You receive your final schedule; hopefully, it still coincides with the preliminary schedule you had received some six weeks earlier when you were hired. In your first semester, you will be teaching six sections of about 20 students per section, making you responsible for the learning of about 120 high school students each day. You note that your class rolls include 19 students with designated learning or emotional disabilities; you will meet with the special education coordinator to learn more about how you will have to modify your instruction to accommodate the special needs of these students. Another 35 of your students are limited-English proficient and you will be responsible for accommodating their learning needs as well, but you will have to wait to get further direction from the ESL department head.*
>
> *Soon, you will get to know all of your students or at least know them as well as you can for the 50 minutes you will share with them daily among the other 1,900 students at your school.*
>
> *You will be teaching two different courses—one typically taken by either freshmen or sophomores and the other by either sophomores or juniors. Your department chair provides you the textbooks and a district curriculum guide for each course. You are to use the curriculum guides to sequence and pace the content of each course so that most of your students start where they ended last year and get where they need to be for end-of-year assessments as well as for next year's math or science course.* (Although, several teachers reported that their districts had no curriculum guides and it was left up to them to determine the scope and sequence of their courses.) *You begin immediately to formulate your instructional plans.*

In the meantime, you are required by the district and your principal to attend a series of orientation meetings for new teachers to acquaint you with district and campus rules and regulations ranging from disciplinary procedures to extra-duty responsibilities to professional development opportunities for new teachers. It's a lot to assimilate in a week, but you'll soon be on your own and ready to go!

Faced with this or similar job scenarios, the 51 teachers were immediately thrust into steep learning curves that accompanied their first year in a classroom. Almost at once they found themselves challenged by competing interests, needs, demands, and realities of their students, colleagues, and administrators. To survive and prosper, they were required to learn rapidly and adapt to their new environment.

Shulman, who extensively studied the practices of medical professionals and educators, commented on the relative complexity of the role of teacher compared to that of medical professional:

After some 30 years of doing such work, I have concluded that classroom teaching—particularly at the elementary and secondary levels—is the most demanding, subtle, nuanced, and frightening activity that our species has ever invented. In fact, when I compared the complexity of teaching with the much more highly rewarded profession, "doing medicine," I concluded that the only time medicine ever approaches the complexity of an average day for a classroom teacher is in an emergency room during a natural disaster (Shulman, 1987, 369-397). *When 30 patients want your attention at the same time, only then do you approach the complexity of the average classroom on an average day* (Wilson, 2004, 504).

In addition to attempting to assimilate myriad organizational norms and cultural attributes of their new districts, schools, and communities, these teachers were primarily working hard to learn about their students, to perfect their interactions with them, and to prepare instruction for them. They reported first-year challenges related to:

- Motivating and engaging students in classroom work,
- Managing student work and behavior in class, and
- Modifying for diverse student learning needs in their classrooms.

Challenges related to student engagement. One of the most startling revelations reported by the new teachers was the lack of engagement and general degree of apathy that they experienced among their students, especially those in required, non-elective courses. Many high school students encountered by these teachers seemed either reluctant or resistant to engage in classroom instruction and learning activities. Representative comments that reflect teacher concerns on the matter follow.

- *I think the biggest challenge is that . . . kids were bored with school and think it doesn't apply to them. So the challenge was making it interesting and exciting for them . . .*

- *I know we all experience academic deficiency, zero work ethic, apathy. Look at kids today, they all have to be entertained. These kids have constant information flow. When they get into class, we have 50 minutes to teach. They don't want to sit there for 45 minutes to learn about density. They don't want to hear us talk. They want us to facilitate. They want to touch, to feel.*

- *I think one of the challenges is finding that balance. Because in the same sentence we talked about needing to entertain our students while facing the reality that they aren't going to be sitting in meetings with a flashy presentation, they need to write things down and use their brain to prepare them for college without those presentations all the time. It is an incredible challenge to meet them where they are and prepare them for where they need to be.*

Managing student work and behavior. Related to issues of motivation, teachers reported challenges in learning how to manage and discipline their students. The following exemplify teachers' concerns in this area.

- *Behavior management was one of my biggest weaknesses and I knew it. I struggled with inconsistency and couldn't get strategies my mother told me about to work.*
- *The first year, my room was a quarter of a mile walk to the office . . . There was no place to send them. I know that what went on in my classroom was my call. I took a lot of abuse but didn't know what else to do.*

Modifying for diverse learners. Classrooms in today's high school are much more complex and diverse than in previous generations. Teachers must learn to adapt and accommodate the special needs of their students. The following comments are illustrative of teacher concerns when they were learning these skills for the first time.

- *My education classes didn't do anything on special needs . . .*
- *It was nice to know about differentiated programs, but that didn't prepare you for eight preps and kids of all levels in the same classroom.*
- *My understanding of special needs students was very limited. My first semester I was not modifying tests or giving alternative assignments. I assumed that all students could do the work—they just needed to try harder. I didn't learn about modifications until later in the year.*
- *I knew that I would have kids with special needs but did not understand how to change or modify concepts for kids who couldn't read or speak English. I did not know how to teach chemistry to kids in special education.*

Grappling with this student context is also consistent with the observations of Susan Moore Johnson (2006) and voiced by subjects in her study of novice teachers in Massachusetts (Johnson, 2004). The struggle to engage students, however, was not only a concern for the Texas teachers during their first year, it was also frequently posed as an ongoing concern during the follow-up focus group conversations some five years later. The difference between their first-year and fifth-year perspectives seemed to be that as these teachers "seasoned" with experience, they were better able to personally accommodate the phenomenon of student apathy and poor work skills through a combination of improved classroom skills and more reasoned expectations. Related to these student issues, teachers reported having to learn how to manage the behavior and channel the work of their students in ways that worked effectively for them.

Challenges related to teaching the content. Teachers also discussed the challenges of effectively teaching their content during their first year. While most teachers in this study felt they entered their jobs with sound academic knowledge, all shared experiences of actually having to learn to teach their content field for the first time. This knowledge of teaching their content was quite different to them than their personal knowledge of their content.

Shulman described teacher knowledge as a set of three inter-related components: (1) content knowledge (i.e., a general acquaintance with the body of knowledge encompassed by the particular field); (2) pedagogical content knowledge (i.e., knowledge of how to teach the content clearly and cogently at appropriate levels of difficulty for learners); and (3) curricular knowledge (i.e. knowledge of appropriate pacing, materials, tools, assessments, etc., used to teach the content).

The first-year instructional challenges described by teachers in this study were generally related to the pedagogical and curricular components of Shulman's teacher knowledge paradigm. Major teaching challenges during the first year for most cohort teachers included:

- Determining appropriate pace and sequence specific to each course being taught for the first time;
- Understanding how to effectively interface the course requirements with school practices related to ongoing review and preparation for state assessments;
- Developing and customizing instructional tools, graphic organizers, activities and/or labs to convey and demonstrate the principles to be taught in a clear, interesting, and coherent manner;
- Finding and planning classroom activities and strategies to actively engage students in learning and to motivate them to participate;
- Formulating practical homework and outside-of-class projects to reinforce and extend classroom instruction; and
- Developing appropriate classroom assessments to determine student understanding and mastery of content.

Support That Matters Most to New Teachers—Overcoming First-Year Challenges

In the face of the first-year learning challenges reported by the 51 Texas teachers, they consistently identified a handful of support factors that helped to sustain them during those precarious early days. Most often cited were the support and suggestions gleaned from teaching colleagues—89% of first-career teachers and 82% of second-career teachers reported this as a primary factor that contributed to first-year success. Mentors were frequently referenced as a key source of this support, particularly among first-career teachers, one of whom observed:

- *My mentor was intentionally helpful; she spent a lot of time with me above and beyond what others might do.*

Department heads and team leaders were often cited as key supporters during their novice year on the job. Teachers also referenced the value of departmental or team planning meetings as valued professional learning opportunities during their first year; one teacher said:

- *My first year during the planning period, I could listen. Anytime I felt concerned, I could talk to them, get reassurance.*

Several teachers stressed the value of district curriculum frameworks and pacing documents as helpful roadmaps for their instructional activities during this initial year; one teacher observed:

- *The district people had set up the learning objectives, pacing, and benchmarking. It was all laid out.*

Conversely, teachers in districts without pacing documents expressed initial confusion and frustration:

- *They didn't do anything . . . They didn't give me a curriculum or anything.*

Both first- and second-career teachers (78% and 92%, respectively) reported their knowledge of subject matter as a critical factor that enabled them to assimilate their course content and devise meaningful lesson plans to teach the material. A comment representative of teacher responses relative to their knowledge of content follows.

- *The one thing I didn't have to learn was the curriculum content. I knew it. I had a strong base . . . otherwise it would have taken tons of time to prepare for the class.*

In addition, 78% of first-career and 75% of second-career teachers credited their own adaptability and perseverance as personal factors that helped overcome first-year challenges, especially noting their facility to modify and adjust their instructional approaches over the course of the year:

- *It's going to be rough your first year. You're going to be trying a lot of things and trying to figure things out. What helped me was being told that the second year was going to be much better.*
- *As a new teacher, you have to be flexible and maintain an attitude of "this too shall pass." The lessons that you put together will fall flat, but you've got to come up with another one and be flexible. You can't really plan for the unexpected, but that's what you really have to do.*

Slightly more than 40% of all teachers identified administrator support as a key contributor in overcoming first-year challenges. Instances of administrative support referenced were most often associated with matters related to student discipline:

- *A good principal is worth $4 per gallon gas and a 20-mile commute.*
- *They are very supportive . . . They take care of kids after we have done our part in the classroom to discipline. They support us.*
- *Our administration is attentive and they follow up . . . The principal is the best manager I've ever had and this is not my first career.*

While teachers reported student relations to be a central determinant in their decisions to continue in the profession, only 47% of second-career teachers and 33% of first-career teachers reported student feedback as critical factors in overcoming their own instructional challenges of their initial year in the classroom. In the words of two teachers:

- *I think that it is hard to perceive that* [student feedback] *as a new teacher.*
- *I didn't ask for feedback. I did get feedback from the students by hearing things which they said. I learned, however, that the student's personal opinions were not the ultimate goal. I would reflect on it when students grumbled, but they weren't able to express their own "learnings."*

Consistent with their observations on initial preparation programs, only about a third of second-career teachers cited prior knowledge of how to teach their subject as a contributing factor in overcoming first-year challenges. Most all reported having to learn their content-based pedagogy on the job; teacher reflections follow.

- *I had a lot of information and wished that I could put it into practice. It was all theory. I had not been able to practice it. I had to try it out on my own, and when I did, I couldn't do it.*
- *I knew the material . . . I just didn't know how to present it to the kids.*

In overcoming the challenges of the first year, the teachers in this study:

- Built on their sound knowledge of subject matter to develop their instructional plans,
- Credited their own professional desire to succeed with their students, and
- Were supported by close, working relationships—first with other teachers followed by their students, campus administrators, and department heads.

Motivation to Continue

The study also sought to identify critical factors that were considered by teachers in making their decision to stay in the teaching profession after their initial years on the job. To this end, most of the cohort teachers identified their relationships with colleagues, their continued interest in their subject, and/or their commitment to working with students as the primary considerations in their choice to remain. Other factors impacting their decisions to either remain in or leave the profession included family considerations, job benefits, and teaching assignments.

Teachers tended to place an extremely high premium on their professional relationships with colleagues; testaments to the strength of these professional relationships follow.

- *My colleagues were friends, almost family.*
- *I had all that support and I know those people were here for me.*

However, having persevered and learned so much during their initial years on the job, these teachers seemed to relish most the opportunity to return for encore performances with their students and to teach in fields that they loved. Comments indicative of teacher sentiments regarding the passion of these teachers for their subject and their students included:

- *I definitely went into teaching to make a difference in kids' lives.*
- *I still wanted to do that, even though I had had a discouraging first year.*
- *The first year was difficult, but I started to understand the kids. I wanted to see them again and see if they had changed.*
- *I have always loved science and I wanted my kids to share that love of science.*
- *I really thought I was making a difference in the way I was teaching and the relationships with the kids. I thought that I was helping a lot of them.*

Salary and job benefits, while important for these teachers, seemed to have less to do with professional decisions than student and collegial relationships, particularly among second-career teachers. These views were summed up in the observation of one teacher:

- *I don't teach for a salary. I teach because I enjoy helping students learn. I enjoy seeing the growth and seeing the light bulb come on. You can't put a price tag on that.*

Seasoned Perspectives

The fifth-year interviews and surveys with members of *51 Math and Science Teachers in Texas* generally revealed more confident and accomplished perspectives, reflecting the deeper professional know-how and richer interpersonal wisdom that they had derived from their experiences on the job. Most conveyed a sound sense of professional self-efficacy as it related to their skills and abilities to deliver instruction and manage their classrooms, reporting that they had mastered the most challenging aspects of teaching that had confounded them in their earlier years. All reported sound relationships with their peers, many reflecting on their own opportunities to mentor and support new teachers in their own schools.

It was interesting to note their differences in views regarding the difficulties of new teacher assignments at their respective campuses. While the majority of the teachers agreed that new teachers receive more challenging assignments, there were considerable differences in opinion largely dependent upon whether they were first- or second-career teachers. Of the second-career teachers, 92% agreed that new teachers get the most difficult classes, most preps and/or worst labs, facilities, equipment. Comments representing the perspective of second-career teachers follow.

- *When veteran teachers are assigned certain classes, which they have worked their way to, the new teachers get what's left over.*
- *I've seen it with new teachers, they get the rough deal. They get more preps, the worst facilities. They have to work their way up.*

Of the first-career teachers, only 33% agreed, with 67% disagreeing, that new teachers were assigned such challenging conditions; their perspective is captured in the following statements.

- *My first year teaching, I didn't feel I had the worst of anything and, looking at new teachers now, they don't get anything worse than anyone else.*
- *At my school, I would never, never put a new teacher in that situation; that's setting them up for failure.*

Overall, two-thirds of the participants reported positive relationships with their campus administrators. Many had experienced the leadership styles of at least two principals during their first five years and even more assistant principals. Again, however, there were marked differences between the perspectives of first- and second-career teachers. When asked whether they felt that principals were generally supportive of teachers, 100% of first-career teachers and 64% of second-career teachers agreed. Teacher views on the subject are exemplified in the following statements.

- *I think that administrators are just trying to do their job and that they have many responsibilities that teachers don't realize.*
- *I think that 90% of the administrators have the heart to support their teachers, but 50% don't have the time or resources to do it…most people (administrators) in education have the heart for it, but not the time to bring balance.*
- *I've always had supportive administrators and I think that part of it is that I am a math teacher; they need good teachers in math.*

The most compelling and passionate agreement among these experienced educators was found in their observations of their own relationships with their students. All of the first-career teachers and 92% of second-career teachers rated their relationships with their students as either positive or very positive. Examples of teacher observations on their student-teacher relationships follow.

- *I relate to the kids and they relate to me. Not that I want to be their friend. I expect respect. They tell me that I respect them.*
- *I work hard to find positives with all students. Those who are working and trying— I am going to find a way for them to find success.*
- *I truly care about them and their learning and they realize that. I don't pull any punches. You get praised and criticized when it's necessary. I have very high expectations.*
- *I try to make the kids feel valued. I encourage them to come to school. I try to make them feel important . . . and give them something positive to look forward to at school.*

Section 4: Summary and Conclusions

This study followed 51 beginning math and science teachers employed by 36 high schools located in four of the fastest-growing sectors of Texas—Dallas-Fort Worth, Greater Houston, San Antonio-Austin, and South Texas-Rio Grande Valley. Across all campuses in the study, the average enrollment was over 1,900 students with over 54% classified as economically disadvantaged.

Most of the teachers (63%) in the study cohort were employed by campuses with student populations between 50% and 100% economically disadvantaged. Approximately 60% of the cohort teachers were math certified, second career, alternatively prepared, and female; the other 40% were science certified, first career, traditionally prepared, and male.

Overall, patterns of retention and attrition for the cohort teachers were consistent with those of secondary math/science teachers statewide; there were substantially more similarities than differences. Thus, the cohort teacher "voices" summarized in this report reasonably reflect those of secondary math and science teachers throughout Texas and, as such, provide the basis for the implications for action that are summarized in the remainder of this report.

Implications for Action

Given the demographic trends extant within the state, Texas will continue over the long term to experience shortages of highly qualified science and math teachers for its high school classrooms. Projected classroom shortages in these critical fields will only be sufficiently addressed through combinations of teacher-supply and teacher-retention strategies. The findings of this report have implications for both sides of this equation.

Accommodating long-term shortages of math and science teachers in Texas high schools will continue to mandate multiple entry points and diversified certification routes. However, the findings of this report suggest that early pathways enabling teacher prospects to pursue the profession as their first career could increase job satisfaction and teacher retention in the future. First-career teachers in this study tended to stay longer, both in the classroom and within the profession, and also reported greater satisfaction with colleagues and administrators.

The issues of math and science teachers in Texas high schools merit the attention and the following concerted actions by education and policy leaders in Texas.

1. Increase the supply of first-career teachers.

The factors that these teachers report as motivators to pursue teaching, as well as their time frame for making career decisions, would seem to be useful guides to strengthen university teacher-recruitment initiatives. The experiences of these teachers suggest a potential pool of young, academically talented teachers formulating career and related college preparation decisions as early as high school.

(a) Develop recruitment in high school. Just as universities pursue gifted athletes, it would seem that science and math classes in area high schools may serve as fertile recruiting grounds for science and math teacher prospects. The significance that high school teachers reportedly played in the decisions of many of these teachers to pursue their particular fields suggests that approaches that enable current high school teachers to systematically nominate prime candidates for university teacher preparation programs could prove to be useful recruitment strategies.

(b) Expand recruitment efforts in college. The findings regarding the timing of career decisions in early college years also reinforces the growing practice of recruiting for math and science teacher candidates among entering freshmen in university colleges of arts and sciences—an approach made popular by the success of the UTeach Program at The University of Texas at Austin.

2. Improve the quality of secondary math and science teacher preparation programs.

There are a number of suggestions herein that might strengthen the curriculum and effectiveness of secondary teacher preparation programs, whether they be alternative or university-based programs. Teachers in this study suggested that they would have benefitted from more (not less) instruction in quality teacher preparation programs. This has implications for present policy regulations in the state, which, since 1986, have regulated certification requirements and limited the number of required course hours for university-based teacher preparation programs.

The experiences and perspectives of teachers in this study suggest that leaders of preparation programs, both alternative and traditional, should consider examining the emphasis and/or depth of their respective programs within two broad areas.

(a) Pedagogical and curricular knowledge should specifically address:

- Deep understanding of the state curriculum and assessment standards and their relationship to the scope, sequence, and pacing of high school math and science course content;
- Instructional tools and graphic organizers to convey and demonstrate key content objects in a clear, interesting, and coherent manner;
- Classroom activities and strategies to actively engage students and motivate them to participate in the learning;
- Practical strategies for classroom management and student disciplinary techniques in high school classrooms;
- Instructional modifications and adaptations for students with special needs, both special education and limited-English proficient;
- Homework and outside-of-class projects to reinforce and extend classroom instruction; and
- Classroom assessments to determine student understanding and mastery of the content.

(b) Field observation and guided practice teaching should consist of multiple opportunities to:

- Observe master teachers of math and science teaching high school students;
- Analyze their observations relative to the key components of pedagogical and curricular knowledge; and
- Apply what they learned in practice teaching situations.

3. Improve the quality of district/campus support for first-year teachers.

First-year challenges reported by these teachers also imply that greater efforts must be made by school districts to accommodate the unique needs of novice teachers. The findings suggest that principals, math/science department heads, and team leaders in Texas high schools should adapt scheduling practices and teacher assignment norms in ways such as the following.

(a) Refrain from assigning first-year teachers the most challenging students.

(b) Limit the number of preparations assigned to new teachers.

(c) Ensure that the mentors of first-year teachers are masters in their content as well as in classroom and student behavior management.

(d) Consider a unique planning schedule for first-year teachers that might include:

- A common conference period with the mentor teacher, ideally at the end of the day to debrief and finalize lesson plans for the following day and
- An extra preparation period specifically to observe the mentor teach the planned lesson, preferably at the beginning of the day so the new teacher can see the lesson in action prior to teaching it for the first time.

(e) Before the first day of instruction, see that new teachers receive specific district and campus guidelines for the content of their courses, particularly as the sequencing and pacing of course objectives relate to end-of-year assessments.

(f) Schedule routine opportunities for new teachers to visit with and learn from campus administrators with regard to student discipline and related behavior and classroom management issues.

(g) Develop and support teacher learning communities that will afford new teachers opportunities to interact with and learn from experienced colleagues in the field.

The findings and implications of *51 Math and Science Teachers in Texas* flow from the experiences and perspectives of Texas high school teachers. They are consistent with similar findings and observations noted in the professional literature and, as such, confirm the needs of teachers reported in state and national studies as well as the qualitative improvements suggested by a range of scholars.

This study has helped us better understand the practical aspects of the challenges that confront classroom teachers as they begin careers in Texas high schools by affording them an opportunity to voice their views and concerns. In order to address statewide shortages of math and science teachers in Texas high schools, it is imperative that we heed their voices.

Bibliography

Alliance for Excellent Education. (2008, February). *What keeps good teachers in the classroom? Understanding and reducing teacher turnover.* (Issue Brief).Washington, DC: Author.

Fuller, E. J. (2006, October). *Teacher quality, distribution, and turnover in Texas*. Paper presented to the Texas Center for Education Policy and University Council on Educational Administration Symposium, Austin, TX.

Fuller, E. J. (2008, October). *Secondary mathematics and science teachers in Texas: Supply, demand and quality.* Austin, TX: Texas Instruments, Inc. and Texas Business Education Council.

Johnson, S. M. (2006, July). *The workplace matters: Teacher quality, retention, and effectiveness.* Washington, DC: National Educational Association.

Johnson, S. M., & The Project on the Next Generation of Teachers (Birkeland, S. E., Donaldson, M. L., Kardos, S. M., Kauffman, D., Liu, E., & Peske, H. G.) (2004). *Finders* and *keepers: Helping new teachers survive and thrive in our schools.* San Francisco, CA: Jossey-Bass.

Johnson, S. M., Berg, J. H., & Donaldson, M. L. (2005). *Who stays in teaching and why: A review of the literature on teacher retention.* Washington, DC: AARP.

MetLife Survey of the American Teacher. (2006). *Expectations and experiences: A survey of teachers, principals, and leaders of college education programs.* New York, NY: Metropolitan Life Insurance Company, Inc.

Rochkind, J., Immerwahr, J., Ott, A., & Johnson, J. (2007). Getting started: A survey of new public school teachers on their training and first months on the job. In C. A. Dwyer (Ed.), *American's challenge: Effective teachers for at-risk schools and students* (pp. 89-102). Washington, DC: National Comprehensive Center for Teacher Quality.

Wheeler, J. A. & Eschberger, D. (2008, November). *50 Texas Mathematics and Science Teachers: Year 3 (2007-2008) Report*. Houston, TX: Region 4 Education Service Center.

Wilson, S. M. (Ed.) (2004). *The wisdom of practice: essays on teaching, learning and learning to teach/Lee S. Shulman*. San Francisco, CA: Jossey-Bass.