SYSTEMIC EQUITY PEDAGOGY IN SCIENCE EDCUATION:

A MIXED-METHOD ANALYSIS OF HIGH ACHIEVING HIGH SCHOOLS

OF CULTURALLY DIVERSE STUDENT POPULATIONS IN TEXAS

A Dissertation

by

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ABSTRACT

The purpose of this study was to identify and describe the associations between systemic equity pedagogy (SEP) practices in highly diverse high schools and their students' science achievement and college readiness. This study focuses on science programs in ten highly diverse Texas high schools serving students who exhibit high science achievement and college readiness. According to the Policy Research Group in Science Education, only two percent of all culturally diverse high schools within the state of Texas demonstrate high science achievement and college readiness on state-tracked school-level indicators.

Transforming a school context where achievement disparities exist among student groups in science classrooms necessitates that public school officials understand key factors, or "drivers," and associated indicators contributing to SEP in programs. A model for programs is suggested using a framework for SEP based on data collected from ten highly successful, high diversity high schools. The following research questions address the research gap regarding indicators of SEP associated with high science achievement and college readiness in highly culturally diverse high schools.

How do data from ten highly successful, high diversity high schools inform the development of a comprehensive SEP rubric?

How do high achieving high schools of culturally diverse student populations score on a comprehensive SEP rubric?

How do teachers' perceptions toward implementing SEP practices vary in different schools?

Three research papers detail the research of this dissertation. The purpose for the first paper is to increase understanding of indicators facilitating systemic and equitable teaching and learning practices, otherwise referred to as systemic equity pedagogy (SEP). Results of the study show indicators of a comprehensive SEP rubric. Together, 127 indicators, thirty categories, and eight SEP drivers form a model framing equitable teaching and learning practices associated with high science achievement and college readiness. In conclusion, indicators within the SEP rubric can be described as action-oriented descriptors that science teachers engage formally or informally in order to facilitate quality science education for all students.

The purpose for paper two is to score equitable teaching and learning practices in highly successful high school science programs based on the SEP rubric. Findings reveals that implementation of various equitable teaching and learning practices vary across science programs and these practices can be described as both pedagogical and non-pedagogical. In conclusion, varying degrees of implementation exist for indicators in the SEP rubric.

In paper three, the purpose is to understand science teachers' attitude and approach toward implementing systemic teaching and learning practices. Results from this study provide scores that indicate science teachers' perceptions of their approach to SEP. This study concludes by suggesting high achieving science programs may operate within a continuum for implementing equitable teaching and learning practices.

DEDICATION

"For I know the plans I have for you,' declares the LORD, 'plans to prosper you and not to harm you, plans to give you hope and a future."

Jeremiah 29:11

First, to my wife, words cannot express the depth of gratitude I have for you due to the support, patience, and love you have demonstrated throughout this journey. The phrase "behind every great man is a great woman" neither is an understatement, nor misrepresentation as I reflect on how you have persisted in your overall support. Additionally, to my precious son, thank you for your smiles, laughs, and pleasant disruptions along the way. May this academic success inspire you and serve as a realistic and personal model that you too can and will achieve heights not yet attained in your family history.

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This particular study would not have been possible without the committed, continuous, and culturally responsive practice of many high school science educators and administrators in ten PRISE-II schools.

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NOMENCLATURE

ARRA	American Recovery and Re-investment Act
NSF	National Science Foundation
SEP	Systemic Equity Pedagogy
PRISE	Policy Research in Science Education
SPI	Science Program Interview
STES	Science Teacher Equity Score
SPES	Science Program Equity Score
TPSST	Texas Poll for Secondary Science Teachers
SASS	Student Aggregate Science Score
MSEP	Minority Student Enrollment Proportion
USI	Urban Systemic Initiative
HSE	High Schools for Equity

CHAPTER I

INTRODUCTION

Science education reforms that positively influence the success of all students must be equitable, systematic and socioculturally adaptive (Barba, 1997; Kahle, 1998; Tobin, Elmesky, & Seiler, 2005). These reforms often involve the promotion of rigorous standards-based curriculum, effective teaching strategies, and new policies related to science education (Warren, Ballenger, Ogonowski, Roseberry, & Hudicourt-Barnes, 2000). In many culturally and linguistically diverse schools, the implementation of quality science instruction resulting in equal achievement for all students is lacking (Atwater, 2010; Banks & Banks, 1995; Borman, 2005; Seiler, 2001; & Tobin, 2006). Inequitable “opportunities to learn science” (Oakes, 1990, p. iii) have been identified as contributing to the disproportionate science achievement in these schools.

Improving student achievement in science education is a priority for public schools. For example, the American Recovery and Reinvestment Act (ARRA) of 2009 provided a historic investment in education reform to raise student achievement in public schools (U.S. Department of Education, 2009). This legislation earmarked more than four billion dollars through state education agencies to improve learning and academic performance in schools. Through the competitive grant program known as Race to the Top Fund, special importance was given to traditionally underrepresented student populations (i.e., African American, Hispanic and Native American) in science, mathematics, and technology education (U.S. Department of Education, 2009). In this program, the participants (i.e., states and public schools) must develop conditions for equitable reform. An important implication of the ARRA legislation was the acknowledgment that equity was central to educational reform (U.S. Department of Education, 2009) with an understanding that thee equitable, systemic, and sociocultural application of effective instructional practices would close the achievement gap, increase graduation rates for underrepresented students, and prepare all students for college and careers (U.S. Department of Education, 2009).

Research on equitable science teaching and learning can provide explanations to help administrators and teachers face the challenges found in culturally diverse classrooms (Kahle, 1998; Hewson, Kahle, Scantlebury, & Davies, 2001; Hammond, 2006; Rodriquez, 2001). Furthermore, Borman et al. (1005) identified key factors, or "drivers," and associated indicators contributing to systemic equity pedagogy (SEP) in science programs. Transforming a school context where achievement disparities exist among student groups in science classrooms necessitates that school officials understand the complexity of the problem.

Definition of Systemic Equity Pedagogy

SEP describes a systems-approach to implementing equity pedagogy within a content area program. The definition of equity pedagogy developed by James A. Banks (1995) is used in this dissertation. Banks (1995) defined equity pedagogy as "teaching strategies and classroom environments that help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function effectively within, and help create and perpetuate, a just, humane, and democratic society" (p. 152). Zirkel (2008) described equity pedagogy as "pedagogical innovations" directed toward the purpose of establishing equitable learning experiences for all students by challenging conditions within the educational environment. (p. 1157). Zirkel (2008) further stated, "One focus of equity pedagogies is to develop and use teaching techniques and methods that can address different learning styles and to develop pedagogical approaches that facilitate the educational achievement of lower performing students" (2008, p. 1157).

SEP considers other factors in the process of influencing equitable teaching and learning and moves beyond the scope of the classroom to influence both content area programs and school-level practices. According to the National Science Foundation's (NSF) Six Drivers of Systemic Reform model, multiple drivers influence systemic and equitable education in science (Borman et al., 2005; NSF, 2000). I have modified the original framework to extend the NSF's model to eight drivers, which ultimately contribute to SEP. My amended SEP framework includes five of six drivers in the NSF model (see below drivers 1-5). Furthermore, I developed the concept for three additional drivers (see below drivers 6, 7 and 8). Drivers in the SEP model include: (1) standards-based curriculum and instructional materials, (2) reform-based policies in science, (3) convergence of resources into science programs, (4) stakeholder supports, (5) student achievement indicators, (6) professional development, (7) professional culture and (8) culturally responsive teaching.

Statement of the Problem

Systemic reform in science education is a priority in many of our nation's high schools, especially those serving culturally diverse student populations. These schools are typically located in economically depressed communities, have few fiscal and material resources for student learning, and lack highly qualified science teachers (Elmesky, Seiler, Tobin, 2005). However, some schools in the state of Texas with proportionally large culturally diverse student populations have closed the achievement gap in science achievement and college readiness for students. According to the Policy Research Group in Science Education (PRISE), high student performance in highly (> 75%) diverse schools occurs in only 2% of all high schools, especially in a climate of sweeping science education reform efforts nationwide (Bozeman & Stuessy, 2011).

Research regarding schools under formalized systemic reform campaigns resulted in the identification of policy drivers and practices (or indicators) contributing to positive academic outcomes (Borman et al., 2005). Schools do exist, however, that have closed the achievement gap without the advantage of any formal and coordinated systemic reform initiative. These schools, such as the 2% of high schools in Texas, have not been studied. There has been no application of identified policy drivers and their indicators to inform others about potential factors contributing to the high academic success in science education and college readiness in these schools (Chenoweth, 2008; Bozeman & Stuessy, 2011). Therefore, the need exists to explore the associations between science teacher practices in high schools and their high science achievement and college readiness.

The study of systemic efforts revealed specific drivers influencing the process of mathematics and science education reform in schools experiencing academic challenges in science education (Borman et al., 2005; Hewson, Kahle, Scantlebury, & Davies, 2001; Kahle, 1998). Drivers were described as “prescribed approaches…NSF developed [as] a model of systemic reform" (Borman, 2005, p. 5). According to the research by Borman and associates, some of the successful outcomes science programs experienced were not limited to high science achievement scores on standardized tests. Other results in schools targeted by systemic reform included promoting equitable teaching practices, meeting curriculum standards, reducing the achievement gap, and developing students prepared for college (Borman et al., 2005; Edmonds, 1979; Hammond, 2006; Hewson, Kahle, Scantlebury, & Davies, 2001; Kahle, 1998; & Rodriguez, 2001).

A study of SEP has not yet been conducted in highly diverse high schools demonstrating high science achievement and college readiness. While studies on the science achievement of culturally diverse students are well documented in the research literature, they primarily involve systemic reform initiatives that intrinsically promote equitable practices (see Borman, 2005; Kahle, 1998; Hewson, Kahle, Scantlebury, & Davies, 2001, 2001; Kim, Crasco, Smith, Johnson, Karantonis, & Leavitt, 2001; & Rodriquez, 2001). In addition, these studies typically focus on schools of different grade levels (i.e. elementary, middle and senior high) within only urban communities. This study distinguishes its focus by concentrating on high schools located within a variety of communities (e.g., rural, suburban, urban, low/high socioeconomic statuses).

Research results can be significant if they lead to effective and systemic ways to improve science education for all students, especially those considered traditionally underserved. A study such as the one reported here could result in the development of innovative and research-based approaches for Texas schools to use in enhancing the equity and quality of their science programs. Additionally, this study establishes a knowledge base regarding equitable systemic practices residing in schools identified for their high levels of student achievement in science and college readiness.

Purpose of Study

The purpose of this study was to identify and describe the associations between systemic equity pedagogy (SEP) practices in highly diverse high schools and their students' science achievement and college readiness. Three chapters report the results of three related investigations, all focusing on the data collected from ten Texas high schools exhibiting high levels of science achievement and college readiness. These ten schools comprised a purposive sample of the 28 high schools in Texas serving large proportions (75% or greater) of culturally diverse student populations and demonstrating high levels of student success in science and college readiness measures.

Research Questions

The following research questions addressed the research gap regarding indicators of equity pedagogy associated with high science achievement and college readiness for students in schools having large culturally diverse student populations.

> How do data from ten highly successful, high diversity high schools inform the development of a comprehensive SEP rubric?
>
> How do high achieving high schools of culturally diverse student populations score on a comprehensive SEP rubric?
>
> How do teachers' perceptions toward implementing SEP practices vary in different schools?

Theoretical Framework

Critical Perspectives and Systemic Equity Pedagogy

Theoretical perspectives of both critical race theory and critical theory uncover supportive and functional aspects of equity pedagogy in this study. I believe that implementation of equity pedagogy within a racially and ethnically diverse context challenges hegemonic and oppressive forces. In turn, these forces contribute to longstanding achievement gaps and conditions fostering inequitable learning experiences for culturally diverse student populations in science education (Atwater, 2010 & Banks & Banks, 1995).

Originating in the legal movement known as critical legal studies, critical race theory emerge as a focus of the intersection of race, culture, and power within American society (Brown, Parson & Rhodes, 2011 & Ladson-Billings, 1999). In both its theoretical and practical nature, critical race theory pursues social justice by uncovering different forms of racism and functions to scrutinize educational inequity (Brown, Parson & Rhodes, 2011 & Ladson-Billings, 1995; 1999). According to Brown, Parson, and Rhodes (2011), "critical race theory insists upon [providing a] historical and contextual analyses of current social and institutional practices" (p. 953). The examination of these ten high school science programs will provide identification of system wide teaching and learning practices associated with the facilitation of equity and academic achievement for all students.

Critical Theory

In Kincheloe and McLaren's (2005) inclusive definition of critical theory, they maintained its goal was to consider "issues of power and justice and the ways that the economy, matters of race, class, and gender, ideologies, discourses, education, religion, and other social institutions, and cultural dynamics interact to construct a social system" (p. 288). Each high achieving science program within the study represents a subset of a larger educational and social system within their respective high schools. Within these particular systems, students of color are succeeding at high levels despite identified oppressive forces such as excessive standardized testing, limited fiscal and material resources, and shortage of highly qualified science teachers. According to Peca (2000), critical theory also focuses "on the oppression of the individual, the group, and of society by self-imposed or externally imposed influences" (p. 2). Peca (2000) suggests emancipating the oppressed necessitates analysis of three forces that she describes as historical, situational, and personal forces.

Historical Forces

Discussions involving academic challenges experienced by traditionally underrepresented student groups (i.e. African American and Latino) in science education appear throughout the literature. Rodriguez (2001) reveals two common historical forces working against science education programs in urban schools. First, students of color (i.e., African American, Hispanic American, and Native American) are traditionally the most underrepresented concerning science achievement (Rodriquez, 2001). Second, the strategies for assessing science achievement using standardized test performance act as an oppressive force because alternative forms of assessments are not equally valued in an era of standards-based curriculum and rigid academic accountability mandates for demonstrated student achievement. Haladyna, Hass, and Nolen (1991) stated:

> No single standardized achievement test represents a complete mapping of the content of the school achievement domain, nor is it so intended by its publishers. Indeed, many critics of standardized testing seek test use reform through the use of multiple indicators that better represent the complexity of school achievement. (p. 3)

Longstanding assessment of academic growth and student achievement with traditional tools such as standardized tests limits the ways to recognize true academic progress in all students (Rodriquez, 2001).

Situational Forces

According to Noguera (2008), prominent factors contributing to disproportionate student performance do not reside only within the physical structure of the campus itself, but in communities surrounding the school. Rodriguez further identifies externally imposed situational forces. These forces act against the progressive movement of equity and academic achievement in schools. According to Rodriquez (2001), urban science programs are often subject to conditions of sustained poverty, lack of resources, low student academic achievement, and violence. These situations are oppressive due to the process of learning for both students and teachers become difficult.

Personal Forces

Unlike historical and situational forces, personal influences appear self-imposed. For example, teachers play a pivotal role in the push for change. Meeting the academic needs of culturally diverse student populations in science requires teachers with high self-efficacy, culturally relevant instructional practices, and content knowledge (Banks & Banks, 1995). Unfortunately, many students of diverse backgrounds (i.e., racial, ethnic, linguistic and low -income status) enter classrooms taught by teachers lacking sufficient training to meet their educational needs (Nieto, 2000).

By analyzing high school science programs selected to participate in this study, I was able to share their stories of educational approaches believed to be successful in teaching culturally diverse students science. Ladson-Billings and Tate (1995) maintain, to "communicate the experience and realities of the oppressed" (p. 58), an essential component to employing a critical perspective is "voice". Therefore, as representatives of the diverse students served within the science program, science faculty member (i.e., science liaison and science teachers) at these schools articulate their practices associated with high science achievement and college readiness.

Rationale for Proposed Chapters

The rationale for this dissertation was to increase understanding of the SEP indicators in schools with high science achievement and college readiness among culturally diverse student populations. This research informs the ability of policymakers to neutralize and reverse trends of disproportionate academic achievement (Edmonds, 1979; Banks & Banks, 1995; Ladson-Billings, 1995; Kahle, 1998). From a review of research literature, this dissertation has established a rubric listing indicators within SEP categories that is generalizable to all Texas high schools serving highly diverse student populations (Chapter 2). Utilizing the rubric, selected schools were then rated and scored on the evidence of SEP categories gathered from interviews and teachers' written comments on a comprehensive instrument requesting information about the employment of SEP in their classrooms (Chapter 3). Finally, based upon this assessment, how science teachers' perceive their approach and attitude toward implementing systemic and equitable practices are investigated (Chapter 4).

The three major chapters included in this dissertation accomplish three important goals: 1) Chapter Two identifies which indicators should be included when creating a comprehensive SEP rubric, 2) Chapter Three scores each school within the sample population using the SEP rubric, and 3) Chapter Four explains how teacher perceptions of their SEP practices vary among the ten high schools.

Research Design

Using a convergent mixed method methodology, I investigated the indicators of systemic equity pedagogy (SEP) in high schools with high science achievement and college readiness (Creswell & Clark, 2011). Figure 1.1 offers a schematic representation of the research design and methodology.

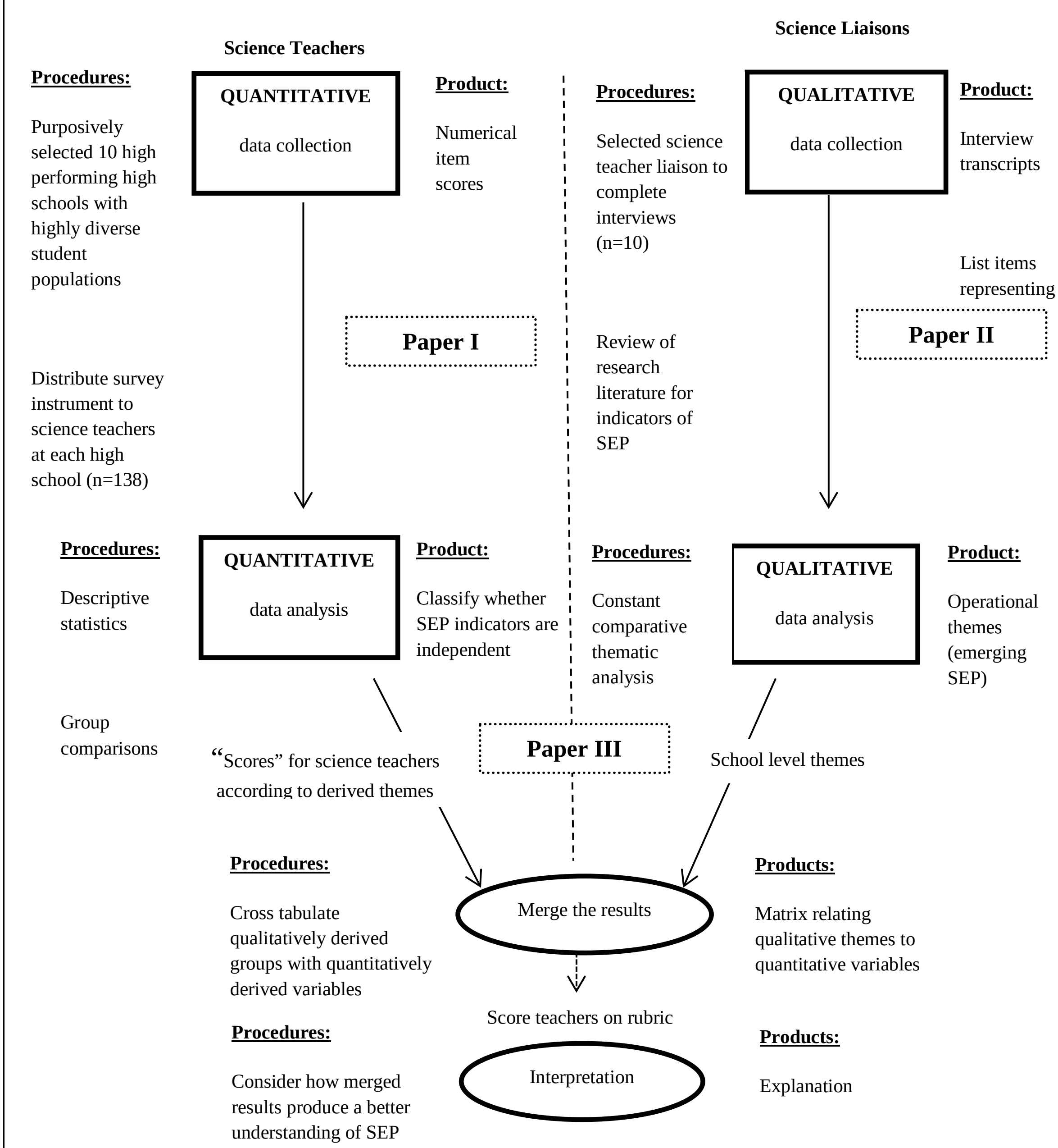

Figure 1.1. Research design schematic. Represents the research plan for three papers.

Conceptual Framework

Factors driving student achievement in science have been identified by analyzing meaningful systemic reform initiatives (Borman, 2005; Hewson, Kahle, Scantlebury, & Davies, 2001; Rodriquez, 2001). As no evidence exists to support the role of a single action producing academic success in complex school systems, a reasonable assumption exists that a variety of tactics are involved in the process of improving science education. In early 2000, assessing the impact of systemic reforms led the National Science Foundation [NSF] to develop six “process and outcome reform drivers” based on a model used for monitoring program support of large school systems (Borman et al., 2005, p. 6). This model is referred to as the NSF Six-Driver Model. Borman and associates (2005) assert that major educational movements in science and mathematics packaged in the form of systemic reforms associated with these drivers have the potential to improve teaching and learning nationwide. A driver-based model incorporating attributes of successful reform initiatives may be a way to assess programs, ensure all students attained high academic achievement, and to add highly skilled individuals to the workforce (Borman et al, 2005).

I modified and extended the NSF’s Six-Driver Model to include eight drivers believed to contribute to SEP associated with high student achievement in science and college readiness. In order to develop a model for SEP, I selected five drivers that originated from the NSF Six-Driver Model (i.e., Standards-based Curriculum & Instructional Materials, Reform-based Practices in Science, Convergence of Resources into Science Programs, Stakeholder Support, and Student Performance Indicators).

These specific drivers describe factors that influence both content area programs and school-level practices. I added the following three drivers that include Professional Development, Professional Culture, and Culturally Responsive Teaching in order to highlight significant attributes that are commonly cited in the research literature on school improvement efforts for culturally diverse students in science. Together these eight drivers contribute to a model that describes and informs the process by which SEP exists.

Borman and Associates (2005) indicate the NSF Six-Driver Model divides into two functional groups, process and outcome. Since the SEP model is a modified and extended version of the NSF Six-Driver model, these two groups remain. In the SEP model, process drivers describe strategic mechanisms that support conditions conducive to equitable teaching and learning. Outcome drivers describe the products that sustain and enact equitable teaching and learning. Process drivers are standards-based curriculum and instructional materials, reform based policies in science education, convergence of resources into science programs and stakeholder supports. Outcome drivers are professional development, professional culture, culturally responsive teaching, and student achievement indicators.

Figure 1.2. Systemic Equity Pedagogy Eight-Driver Model. Adapted from the National Science Foundation (2000) "Six Critical Drivers" model of systemic reform available at http://www.ehr.nsf.gov/EHR/driver.asp. The additional drivers, Professional Development, Professional Culture, and Culturally Responsive Teaching were added to represent a complete list of factors that are associated with highly diverse high schools and their students' science achievement and college readiness.

Operational Definitions

The following definitions assist readers' understanding of SEP drivers and other terms. An explanation of each term is based on literature resources and/or descriptions of general and widespread practices common in a public high school science program.

(1) Standards-based Curriculum and Instructional Materials

In Borman's (2005) study, aligning curriculum resources and instructional activities with academic standards in science functions as a model to produce quality lessons for student mastery of knowledge and skills. The standards-based curriculum used by schools in my study is based on the Texas Essential Knowledge and Skills (TEKS) for Science. These academic standards "help students develop a foundation of skills that they can employ to successfully pursue a variety of college majors" (Educational Policy Improvement Center, 2009, p. iii).

(2) Reformed-based Policies in Science Education

At the school-level, principals are driving forces in implementing reformed-based policies in science education (Borman, 2005). Principals interviewed in Borman's study on systemic reform summarized the indicators of successful reform-based policy implementation as "professional development; school demographic factors such as student ethnicity, language use, and socioeconomic status; and most importantly, school vision, attitudes, and guiding principles supporting a culture of reform" (Borman, 2005, p. 41).

(3) Convergence of Resource

The NSF's Six-Driver Model recommends merging all "fiscal, intellectual, [and] material" resources to support systemic reform improvements in science education (NSF, 2000). Decades earlier, Edmonds (1979) operationally defined this approach as equitable and thus effective to educating all students, especially those who are ethnically diverse and from low socioeconomic backgrounds.

(4) Stakeholder Supports

Support for schools to achieve academically extends beyond the ability of individual teachers and school administrators. Stakeholders are observed participating in various ways to assist schools involved in systemic reform to meet high academic goals (Borman, 2005). Borman (2005) defines stakeholders as "district personnel, principals, teachers, and other school staff, students, parents and guardians, and individuals from businesses, faith-based organizations, and government and community agencies" (p. 49).

(5) Student Achievement Indicators

Student achievement indicators include tools and procedures schools use to monitor student performance. These devices include both formative and summative instruments such as standardized tests, benchmark assessments, student portfolios, and project based learning.

(6) Professional Development

School leaders can facilitate change in the science education program and directly benefit student achievement by providing ongoing, relevant, and high quality professional development for science teachers (Kardos & Johnson, 2007). Ongoing professional training provides science teachers with support in critical areas of content knowledge and pedagogical skill. Sato, Roehrig, and Donna (2010) also determined on-going professional development contributes to the retention of science teachers, especially those new to teaching science.

(7) Professional Culture

Professional culture describes "established modes of professional practice among teachers, their norms of behavior and interaction, and the prevailing institutional and individual values that determine what teachers do and how they do it" (Kardos & Johnson, 2007, p. 2086). A healthy professional culture supports teachers' sense of belonging, connectedness with others, and attitude toward their practice which supports science achievement and college readiness (Bozeman & Stuessy, 2011; Kardos & Johnson, 2007; Ruebush, 2012). Borman et al. (2005) states, "Strong, nurturing culture within a school fosters the development of teacher leadership, and in turn should produce positive results in student outcomes" (p. 198).

(8) Culturally Responsive Teaching

Descriptions of teaching as social (Tobin et al., 2005) and cultural (Stigler & Hiebert, 1999) activities emphasize the necessity to consider relative and responsive approaches to educating ethnically diverse student groups. According to Ladson-Billings (1995) and Gay (2002), instruction that enhances academic competence, incorporates the students' cultural background in learning experiences, and meets the social and emotional needs of students demonstrates pedagogy that is culturally relevant and culturally responsive. Nurturing academic competence occurs as teachers improve content knowledge and effective teaching strategies in science (Schroeder, Scott, Tolson, Huang, & Lee, 2005). Content integration and assessment strategies incorporating students' cultural background into teaching and learning experiences are characteristic of equity pedagogy (Banks & Banks, 1995).

(8) Student achievement indicators.

The Student Aggregate Science Score (SASS), SASS incorporates performance indicators used by the state of Texas to measure high school success in science and college readiness (Stuessy and Bozeman, 2010). According to Stuessy and Bozeman (2010), “this variable [is] used to determine the relationships of school support practices and teacher characteristics to positive student outcomes in science”.

Summary

This dissertation consists of five chapters. Chapter One provides an introduction of the research topic on SEP and science programs. Chapter Two, provides a literature review and reports the results of my research accomplishing three areas: (First) identify school/science program indicators of SEP, (Second) examine how equity pedagogy school indicators cluster into distinct drivers, and (Finally) collect evidence supporting the relationship of SEP to attributes of high science achievement and college-readiness. Chapter Three describes my methodology and reports my analysis of relationships between teachers’ indicators of SEP drivers with science achievement, college readiness, and aspects of teacher demographics (i.e., race, gender, and years of experience). Chapter Three also reports results of analyses determining the associations of each of the drivers with one another. Chapter Four determines the relationship between SEP drivers and teachers' perceptions of their practices. Finally, in Chapter Five, I propose a strategy for implementing SEP in other high school science programs. This research will inform stakeholders (i.e. teachers, administrators, and policymakers) about the SEP practices occurring in ten of 28 highly successful, highly diverse high schools, which can be used in their deliberations regarding the development of their own equitable science programs leading to high science achievement and college readiness for all students.

CHAPTER II

SUCCESS BEYOND REFORM: INDICATORS OF HIGH SCIENCE ACHIEVEMENT AND COLLEGE READINESS IN HIGH SCHOOL OF CULTURALLY DIVERSE CONTEXTS

In 2010, the Policy Research Initiative Group in Science Education (PRISE) developed a variable related to student outcome in science. Referred to as the Student Aggregate Science Score (SASS), SASS incorporates performance indicators used by the state of Texas to measure high school success in science and college readiness (Stuessy and Bozeman, 2010). According to Stuessy and Bozeman (2010), analysis "this variable [is] used to determine the relationships of school support practices and teacher characteristics to positive student outcomes in science". Further analysis by the PRISE Research Group revealed approximately 2% of culturally diverse high schools in Texas "were identified as being well prepared in science and ready for college" (Stuessy and Bozeman, 2010). Table 2.1 illustrates the distribution of high school science achievement by diverse student enrollment in the state of Texas is available.

This startling evidence of present and inequitable science achievement signal concerns of an existent achievement gap in many Texas high schools. However, the 2% of highly successful high schools mentioned earlier represent the potential transformation that can result when all students experience equitable teaching and learning in science. According to Caldwell and Spinks' (2008) description, "transformation is significant, systematic and sustained change that secures success for all students in all settings, thus contributing to the well-being of the student and society".

Borman (2005) suggests the core of this reform is a focus on educational equity. The opportunity is afforded in this study to identify specific equitable teaching and learning practices at work within the science programs at these high schools and also associated with high science achievement and college readiness.

Table 2.1

Distribution of Texas High Schools by Minority Student Enrollment Proportion and Science Achievement and College Readiness

		Quartile Category	Number (%) Within a Category	% All Schools (out of 1370)
1370 All High Schools in Texas	327 Highest MSEP 27.2%	4th Quartile SASS	28 (7.5%)	2.04%
		3rd Quartile SASS	41 (11.0%)	3.00%
		2nd Quartile SASS	127 (34.1%)	9.27%
		1st Quartile SASS	176 (47.4%)	12.85%
	293 High MSEP 21.4%	4th Quartile SASS	66 (22.5%)	4.82%
		3rd Quartile SASS	73 (24.9%)	5.33%
		2nd Quartile SASS	77 (26.3%)	5.62%
		1st Quartile SASS	77 (26.3%)	5.62%
	216 High MSEP 15.8%	4th Quartile SASS	81 (37.5%)	5.91%
		3rd Quartile SASS	56 (25.9%)	4.09%
		2nd Quartile SASS	45 (20.8%)	3.28%
		1st Quartile SASS	34 (15.7%)	2.48%
	487 Lowest MSEP 37.7%	4th Quartile SASS	158 (32.3%)	11.53%
		3rd Quartile SASS	152 (31.1%)	11.09%
		2nd Quartile SASS	108 (22.19%)	7.88%
		1st Quartile SASS	71 (14.5%)	5.18%

Note. Minority student enrollment proportion (MSEP) Stuessy and Bozeman (2012).

Rationale

The rationale for this paper is to increase understanding of indicators facilitating systemic and equitable teaching and learning practices, otherwise referred to as systemic equity pedagogy (SEP). This study focuses on equitable teaching and learning practices associated with high science achievement and college readiness within ten successful Texas high schools of proportionally large culturally diverse student populations (Stuessy and Bozeman, 2012). This research is critical because the potential exists for schools to neutralize and reverse trends of disproportionate academic achievement as all students, especially those of color, experience systemic and equitable pedagogy in science education (Atwater, 2010; Banks & Banks, 1995, 2004; Borman, 2005; Edmonds, 1979; Howell, Lewis, & Carter, 2011; Ladson-Billings, 1995; Kahle, 1998). Based on a review of research and interview transcripts involving science teachers in the ten successful schools, a rubric listing SEP drivers, categories, and indicators is developed. The purpose of this research effort is to identify SEP indicators which facilitate equity within high school science programs and are associated with high science achievement and college readiness.

Problem Statement

A study of SEP has yet to be conducted in high schools of proportionally large culturally diverse student populations exhibiting high science achievement and college readiness. While studies about the science achievement of students of color are well documented in the research literature, these studies primarily involve systemic reform initiatives that intrinsically promote equitable practices (see Kahle, 1998; Rodriquez, 2001; Hewson, Kahle, Scantlebury, & Davies, 2001; Kim, Crasco, Blank, & Smithson, 2001; Borman, 2005). In addition, these studies typically focus on schools of different grade levels (i.e. elementary, middle and senior high) within only urban communities. This study is distinct by focusing on only high schools located within a variety of rural, suburban and urban communities. Finally, this study identifies SEP indicators associated with high science achievement and college readiness.

Conceptual Framework

Factors driving student achievement in science have been identified by analyzing meaningful systemic reform initiatives (Borman, 2005; Hewson, Kahle, Scantlebury, & Davies, 2001; Rodriquez, 2001). As no evidence exists to support the role of a single action producing academic success in complex school systems, a reasonable assumption exists that a variety of tactics are involved in the process of improving science education. In early 2000, assessing the impact of systemic reforms directed the National Science Foundation [NSF] to develop six “process and outcome reform drivers” (Borman, 2005, p.6). Collectively, these drivers constitute the NSF’s Six-Driver Model representing critical reform-based policies (or drivers) important to monitoring the transformation of science education programs within educational systems, including schools (Borman, 2005). See Table 2.2 for the NSF Six-Driver model.

According to Borman (2005), major educational initiatives in science and mathematics come packaged as systemic reforms seeking to improve teaching and learning. Their purpose is to ensure all students attain high academic achievement and ultimately become highly skilled individuals in the workforce (Borman, 2005).

Examples of such educational initiatives include the Upward Bound Math and Science Program and El Paso Collaborative for Academic Excellence.

Table 2.2.

NSF Six-Driver Model

Driver	Description
Driver1	Implementation of a comprehensive, standards-based curriculum and / or instructional materials that are aligned with instruction and assessment available to every student by the system and its partners.
Driver 2	Development of a coherent, consistent set of policies that support provisions of broad-based reform of mathematics and science at the K-12 level.
Driver 3	Convergence of all resources that are designed for or that reasonably could be used to support science and mathematics education-fiscal, intellectual, materials- both in formal and informal education settings, into focused program that upgrades and continually improves the educational program in science and mathematics for all students.
Driver 4	Broad-based support from parents, policymakers, institutions of higher education, business and industry, foundations, and other segments of the community for the goals and collective value of the program that is based on an understanding of the ideas behind the program and knowledge of its strengths and weakness.
Driver 5	Accumulation of broad and deep array of evidence that the program is enhancing student achievement through a set of indices. In the specific instance of student achievement test scores, awardees on an annual basis are expected to report the results of student mathematics and science achievement in a multigrade level context for the USI-impacted school / district / states(s) relative to appropriate cohort entities (non-USI districts, the state), all of which are defined by the performance baselines.
Driver 6	Improvement in the achievement of all students including those historically underserved, as evidenced by progressive increments in student performance characterized by the requisite specificity of the USI as a catalytic resource and the appropriateness of attendant attributions.

Note. NSF, 2000. Urban Systemic Initiatives (USI).

The goal of Upward Bound is to “help students recognize and develop their potential to excel in math and science and to encourage them to pursue postsecondary degrees in math and science, and ultimately careers in the math and science profession” (U.S. Department of Education, 2012). The Upward Bound program collaborates with secondary and post-secondary educational institutions to help students traditionally underrepresented in math and science academic programs. The Collaborative involves a network of El Paso area school districts, post-secondary institutions, businesses and community organizations all working together to improve K-12 math and science achievement. The Collaborative conducts its work with the support of NSF funded grants in order to build instructional capacity in teachers, develop local curriculums aligned with national standards, and engaging higher education faculty to support K-12 student achievement (2011). The NSF Six Driver Model has functioned to assess the influence of these kinds of reform initiatives in schools and other educational institutions. For more than a decade, the NSF Model has served as an assessment instrument for educational institutions involved in systemic reform. However, another model is needed to assess academic programs in schools not involved in systemic reform initiatives.

This study develops a new model referred to as the systemic equity pedagogy (SEP) model (see Figure 2.1). The SEP model consists of eight drivers as a modified and extended version of the NSF’s Six-Driver Model. The SEP model differs from the NSF model in three ways. First, the SEP Model assesses academic program within school not involved in systemic reform. Second, this model measures academic program based on ideological, operational and pedagogical indicators identified within highly successful science programs with proportionally large culturally diverse student populations.

Figure 2.1. Diagram of the drivers of Systemic Equity Pedagogy. Adapted from the National Science Foundation (2000) "Six Critical Drivers" model of systemic reform available at http://www.ehr.nsf.gov/EHR/driver.asp. The additional drivers, Professional Development, Professional Culture, and Culturally Responsive Teaching were added to represent a complete list of factors that associate with highly diverse high schools and their students' science achievement and college readiness.

Third, the SEP model evaluates for culturally responsive teaching and professional culture as drivers within this framework. The SEP model entails reform-based drivers strategic for monitoring school program-level mechanisms of equitable teaching and learning practices in science education. I believe the implementation of reform-based policies, like those in NSF's Six-Driver Model, can give rise to different practices, strategies, and approaches school administrators and teachers utilize in order to meet them. In contrast, equitable teaching and learning practices documented in the SEP model and identified in these highly successful schools can form the knowledge base by which effective policies are developed for culturally inclusive science programs. Therefore, my study will utilize the SEP model to identify indicators of equitable teaching and learning practices associated with high science achievement and college readiness.

In order to identify these indicators, science teacher practices within the ten PRISE high schools were linked to the SEP drivers and categories. Similar to the NSF Six-Driver Model, SEP drivers divide into two groups, process and outcome. Process drivers describe the mechanisms that support conditions conducive to equitable teaching and learning within a high school science program. Outcome drivers describe the products that sustain and enact equitable teaching and learning. All subsequent categories and indicators fall into one of the two groups (i.e., process and outcome).

Theoretical Framework

Critical Perspectives and Systemic Equity Pedagogy

Theoretical perspectives of both critical race theory and critical theory uncover supportive and functional aspects of equity pedagogy in this study. I believe that implementation of equity pedagogy within a racially and ethnically diverse context challenges hegemonic and oppressive forces. In turn, these forces contribute to longstanding achievement gaps and conditions fostering inequitable learning experiences for culturally diverse student populations in science education (Atwater, 2010 & Banks & Banks, 1995).

Originating in the legal movement known as critical legal studies, critical race theory emerges as a focus of the intersection of race, culture, and power within American society (Brown, Parson & Rhodes, 2011 & Ladson-Billings, 1999). In both its theoretical and practical nature, critical race theory pursues social justice by uncovering different forms of racism and functions to scrutinize educational inequity (Brown, Parson & Rhodes, 2011 & Ladson-Billings, 1995; 1999). According to Brown, Parson, and Rhodes (2011), "critical race theory insists upon [providing a] historical and contextual analyses of current social and institutional practices" (p. 953). The examination of these ten high school science programs will provide identification of system wide teaching and learning practices associated with the facilitation of equity and academic achievement for all students.

Critical Theory

In Kincheloe and McLaren's (2005) inclusive definition of critical theory, they maintain its goal is to consider "issues of power and justice and the ways that the economy, matters of race, class, and gender, ideologies, discourses, education, religion, and other social institutions, and cultural dynamics interact to construct a social system" (p. 288). Each high achieving science program within the study represents a subset of a larger educational and social system within their respective high schools. Within these particular systems, students of color are succeeding at high levels despite identified oppressive forces such as excessive standardized testing, limited fiscal and material resources, and shortage of highly qualified science teachers. According to Peca (2000), critical theory also focuses "on the oppression of the individual, the group, and of society by self-imposed or externally imposed influences" (p. 2). Peca (2000) suggests emancipating the oppressed necessitates analysis of three forces that she describes as historical, situational, and personal forces.

Historical Forces

Discussions involving academic challenges experienced by traditionally underrepresented student groups (i.e. African American, Hispanic, and Native American) in science education appear throughout the literature. Rodriguez (2001) reveals two common historical forces working against science education programs in urban schools. First, students of color (i.e., African American, Latinos, and Native American) are traditionally the most underrepresented concerning science achievement (Rodriquez, 2001). Second, the strategies for assessing science achievement using standardized test performance act as an oppressive force because alternative forms of assessments are not equally valued in an era of standards-based curriculum and rigid academic accountability mandates for demonstrated student achievement. Haladyna, Hass, and Nolen (1991) stated:

> No single standardized achievement test represents a complete mapping of the content of the school achievement domain, nor is it so intended by its publishers. Indeed, many critics of standardized testing seek test use reform through the use of multiple indicators that better represent the complexity of school achievement. (p. 3).

The longstanding assessment of academic growth and student achievement with traditional tools such as standardized tests limits the ways to recognize true academic progress in all students (Rodriquez, 2001).

Situational Forces

Noguera's (2008) perspective is prominent factors contributing to disproportionate student performance do not reside within the physical structure of the campus itself, but in communities surrounding the school. Serious social and economic limitations in some communities schools are located create burdens for their academic programs. Rodriguez identifies externally imposed situational forces. These forces act against the progressive movement of equity and academic achievement in schools. According to Rodriquez (2001), urban science programs are often subject to conditions of sustained poverty, lack of resources, low student academic achievement, and violence. According to Olson, Winter, and Zuniga (2004) "rural schools share many of the same challenges as urban schools in urban settings, with lack of funding and resources, aging facilities, and difficulty finding and retaining quality teachers are commonplace (p. 377)." These situations are oppressive due to the process of learning for both students and teachers become difficult.

Personal Forces

Unlike historical and situational, personal forces appear self-imposed. For example, teachers play a pivotal role in the push for change. Meeting the academic needs of culturally diverse student populations in science requires teachers with high self-efficacy, culturally relevant instructional practices, and content knowledge (Banks & Banks, 1995). Unfortunately, many students of diverse backgrounds (i.e., racial, ethnic, linguistic and low -income status) enter classrooms taught by teachers lacking sufficient training to meet their educational needs (Nieto, 2000).

By analyzing high school science programs selected to participate in this study, I am able to share stories of educational approaches believed to be successful in teaching culturally diverse students science. Ladson-Billings and Tate (1995) maintain, to "communicate the experience and realities of the oppressed" (p. 58), an essential component to employing a critical perspective is "voice". Therefore, as representatives of the diverse students served within the science program, science program faculty member (i.e., science liaison and science teachers) at these schools articulate their practices associated with high science achievement and college readiness.

Focus of Literature Review

Successful academic performance in science education is an imperative for all students, especially in high school. Due to this fact, the National Academy of Science committee, Conceptual Framework for New K-12 Science Education Standards, offers a viewpoint of what academically successful students in science are expected to accomplish upon completing high school studies. These expectations include a fascination and excitement for science, sufficient knowledge to engage in discussion involving science and engineering, the ability to become consumers of scientific and technological information, and the possession of skills to enter any career field, especially in science, technology and engineering (National Academy of Science, 2012). This level of achievement allows students to meet graduation requirements, college readiness standards, and prepares them to pursue post-secondary opportunities in science-related fields (U.S. Department of Education, 2009).

The national science achievement test score gap in regard to student race/ethnicity continues. According to the 2009 Nation's Report Card in Science at grade twelve, White and Asian students significantly out perform African American, Latino, and Native Americans students (National Center for Education Statistics, 2009). While test scores for White and Asian students reveal no statistical variation, the report indicates "the score gap between White and African American students was 34 points, and the gap between White and Latino students was 25 points" (National Center for Education Statistics, 2009, p. 47). Prior year scores reveal similar disproportionate student performance outcomes for both middle school and high school students across the nation (see Figure 2.2).

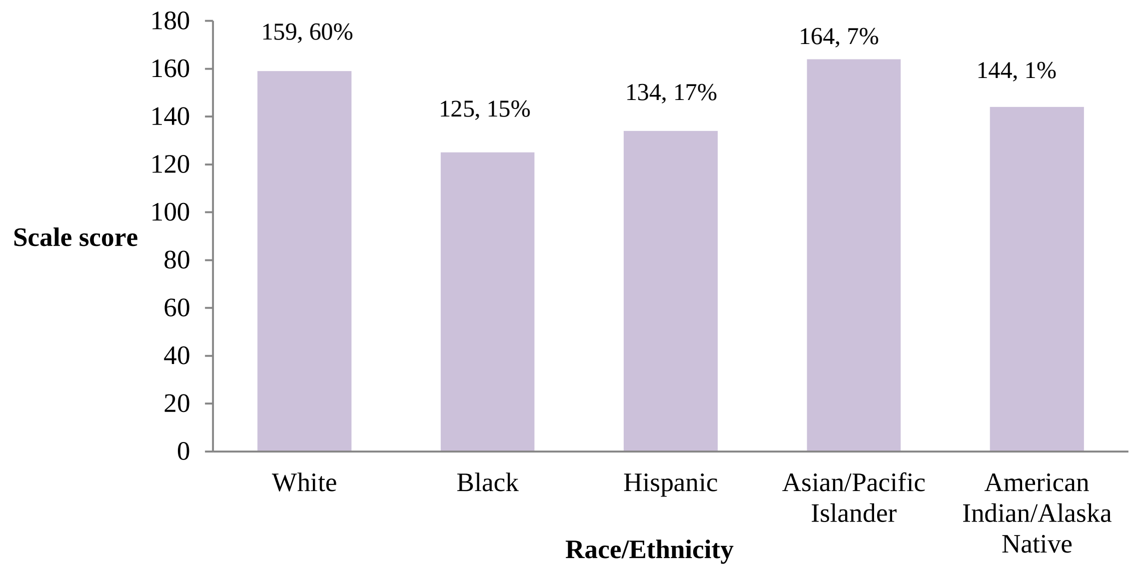

Figure 2.2. NAEP Student Average Scores in Science, Grade 12. Source: U.S. Department of Education, Institute of Education Science, National Center for Education Statistic, National Assessment of Educational Progress (NAEP), 2009 Student Assessment.

Behind these disproportionate student performance outcomes is what Atwater (2000) argues is “inequitable experiences that [many students of color] have in science education in the United States” (p. 155). For many African American, Latino and Native

American students, becoming “scientifically literate high school graduates” requires equitable and quality science learning (Atwater, 2000, p. 154).

Equitable High Schools

A pivotal study which roots and provides context for an analysis of equitable teaching and learning practices based on highly successful science programs is the High Schools for Equity (HSE) project by Friedlaender and Darling-Hammond (2007). HSE involves a statewide study of high achieving urban high schools in the state of California. Similar to the PRISE research, this study identifies high achieving schools using multiple selection criteria including both high graduation and college entrances rates. The use of graduation and college entrance rates are an important distinction to highlight due to implications of college readiness. Based on other parameters including proportionally large culturally diverse student population, school setting, socioeconomic status, and student achievement, three hundred sixty high schools were considered for participation in this study. However, only five schools were chosen, retaining a small sample for qualitative analysis.

The purpose of the HSE study is to document the practices, design features, and achievement outcomes of five urban high schools successful at preparing predominately low-income students of color for college. Additionally, this study provides policy recommendations with the intention to develop, maintain, or transform schools into equitable and just learning for all students (Friedlaender and Darling-Hammond, 2007). Using qualitative research methods involving case study, the researchers did explore significant design components that appear to facilitate effective and equitable academic support to all students (Friedlaender and Darling-Hammond, 2007). Like the PRISE-II study, the HSE research team visited these schools and held discussions with principals, teachers, and even students. The HSE research team made observations and documented field notes that detailed inner workings of the educational program at each school. According to Friedlaender and Darling-Hammond (2007), these five schools possessed "features, which are mutually reinforcing, aim[ing] to create personalized schools which offer rigorous and relevant instruction that is supported by professional collaboration and learning" (p. viii).

In many Texas high schools, similar disproportionate academic performance in science education occurs among culturally diverse student groups (see Figures 2.3 and 2.4). This alarming phenomenon has troubling implications concerning academic and future career opportunities for culturally diverse students. Academic performance reports of standardize tests for tenth and eleventh grade students in science reveals African American and Latino students performed significantly lower than other racial/ethnic student groups in eight consecutive years. Caucasian, Asian and many Native American student groups performed higher during the same time period. While the science performance results for all students appear higher in 2011 than results in 2003, an obvious test score gap remains.

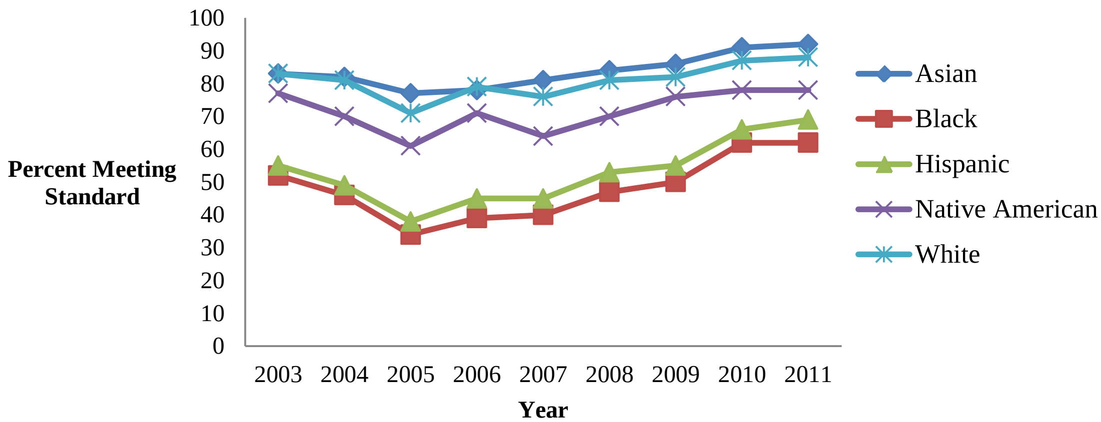

Figure 2.3. Standardized Science Test Scores in Texas, Grade 10. Source: Texas Education Agency, Texas Assessment of Knowledge and Skills (TAKS) Summary Report.

Implementing equitable instructional practices is the broad emphasis of studies on systemic reform in science education. Promoting equity is a central element in several research studies on this topic (see Hammond, 2006; Hewson et al, Kahle, Scantlebury, & Davies, 2001; Kahle, 1998; Rodriquez, 2001). Research in this area provides insight into instructional strategies promoting equity pedagogy (Hammond, 2006 & Hewson, Kahle, Scantlebury, & Davies, 2001), factors that influence equity in urban science classrooms settings (Rodriguez, 2001), and rubrics for evaluating specific reform efforts to promote equity (Kahle, 1998). We look to future research on systemic reform and equity in hopes that these studies will fill the existing gap in the literature and provide answers to the problems that continue to keep culturally diverse students from reaching their fullest potential. To that end, current research literature sparsely addresses how schools can systemically promote science achievement and college readiness for all students apart from the support of reform initiatives.

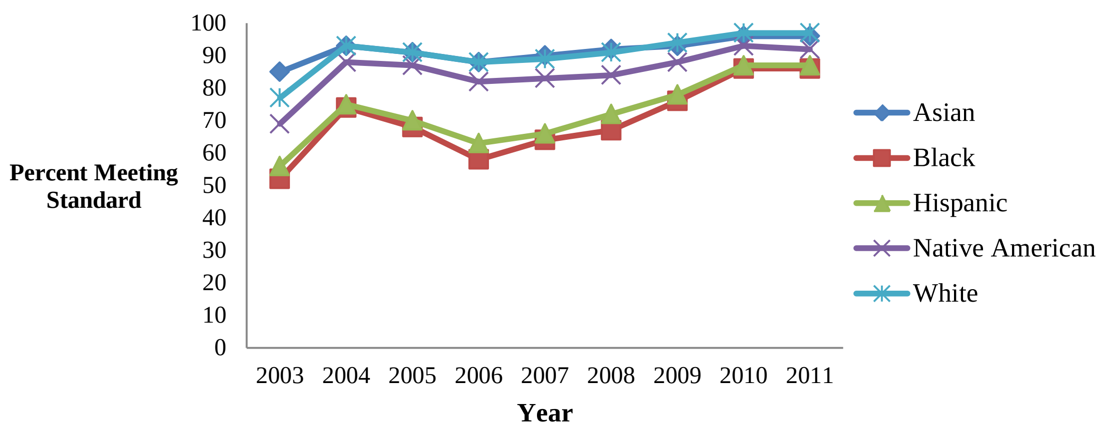

Figure 2.4. Standardized Science Test Scores in Texas, Grade 11. Source: Texas Education Agency, Texas Assessment of Knowledge and Skills (TAKS) Summary Report.

Indicators of Equity

Rodriquez (2001) shares his findings of indicators within successful systemic reform initiatives that promote equity and student achievement in diverse urban contexts. According to Rodriguez (2001) and Kahle (1998), reform initiatives maintaining systemic conceptual clarity synced with ideological, pedagogical and operational components contribute to the improvement of access, participation, and achievement of traditionally underrepresented students in science. Systemic conceptual clarity is defined as a shared vision within the organization (Rodriguez, 2001). This involves stakeholders such as school district officials, campus administrators, teachers, parents, community members, and students. An ideological component involves “the pragmatic understanding of how social justice issues (i.e., equity, gender inclusion, multicultural education, disability, etc.) can be addressed in the specific cultural and socioeconomic context in which reform is being implemented” (Rodriguez, 2001, p. 1120).

Hewson, Kahle, Scantlebury, & Davies (2001) shares case study findings from two urban middle schools. In his study, school culture and school climate were identified as major factors within a school system that support equitable teaching and learning practices in science education. Kahle’s (1998) equity metric has been used to assess how schools progress toward equity while involved in a systemic reform initiative. Kahle’s metric provides a framework listing indicators of equity. These indicators are comprised of four categories including access, retention, achievement, and overall contributing values (Hewson, Kahle, Scantlebury, & Davies, 2001& Kahle, 1998). This metric is used to evaluate how well systemic reform initiatives progress toward equity.

Factors of Achievement

Factors driving student achievement in science have been identified by analyzing meaningful systemic reform initiatives (Borman, 2005; Hewson, Kahle, Scantlebury, & Davies, 2001; & Rodriquez, 2001). As no evidence exists to support the role of a single action producing academic success in complex school systems, a reasonable assumption exists that a variety of tactics are involved in the process of improving science education.

Research Question

What indicators should be identified to develop a comprehensive SEP rubric?

Methods

Research Design and Participants

The PRISE-II Research Group, located in the College of Education and Human Development at Texas A&M University, collected data to inform the development of the SEP rubric. The participants in this study were science teacher liaisons within the high schools selected by purposeful sampling. Each of the ten participants was identified by their respective school principal as the "science liaison."

Research Context

This research effort involved Texas high schools with proportionally large culturally diverse student populations. These high schools were located in rural, urban, and suburban communities throughout Texas. The ten high schools met the criteria for inclusion in this study because of high performance in science and large culturally diverse student populations (i.e., student enrollment proportion > 75% African American, Latino, and Native American students).

Selection of Participants

The PRISE-II Research Group selectively chose ten of the 29 Texas high schools identified as having large culturally diverse student populations that were also highly successful in science achievement and college readiness (Bozeman and Stuessy, 2011). Formal letters, telephone contacts, and campus visits describe efforts used to request the participation of each campus principal in the ten high schools. After meeting face-to-face with each high school principal, we were granted access to conduct our study with the science liaisons.

Data Collection

Qualitative data was collected in this study using structured interviews. The PRISE Research team conducted ten, 60-minute structured interview sessions with science teacher liaisons at their high school campus. Each one-on-one interview was recorded using a digital audio recorder, and field notes were taken. The instrument used to collect data was the 29-item Science Program Interview (SPI) document (see Appendix A for the Science Program Interview). The SPI focused on four elements within a high school science program. These elements focused on the organization, curriculum, instructional priorities, and vision of the science program (Stuessy & Bozeman, 2011). The purpose was to collect data which described specific equitable teaching and learning practices (or indicators) within high achieving high school science programs. Ascertaining this information revealed science teachers' perspectives toward implementing equitable teaching and learning practices. Additionally, the interviews provided perspectives of the instructional practices used to meet the needs of the culturally diverse student populations. The science teacher liaisons' interpretations are used to informs the list of indicators within the SEP rubric. Table 2.3 illustrates SEP drivers that correspond to the SPI instrument.

Table 2.3

Corresponding SEP Drivers to Science Program Interview Items

Driver	Systemic Equity Pedagogy	Science Program Interview Items
1	Standard-based Curriculum and Instructional Materials	10a, 11, 12, 13
2	Reform-based Policies in Science	14a, 14b, 14c, 14d, 25
3	Convergence of Resources into Science Programs	11, 13
4	Stakeholder Support	1, 2, 3, 5, 6
5	Student Achievement Indicators	20, 22
6	Professional Development	7a, 7b, 8
7	Professional Culture	10a, 16, 25, 26, 27a, 27b, 28, 29
8	Culturally Responsive Teaching	14a, 18a, 18b, 19a, 19b, 19c, 24

Note. Science program data collected the Science Program Instrument.

Data Analysis

I obtained data for this study from several sources: electronic audio recordings, verbatim interview transcripts,; peer review journal articles and other scholarly literature, and the Science Program Interview instrument. I proceeded through several stages in analyzing the qualitative data. Following these stages, I analyzed the Science

Program Interview transcripts and other scholarly literature in order to develop a comprehensive SEP rubric.

Developing the SEP Rubric

Whereas the NSF model maintained only six drivers in its framework, the SEP rubric includes two additional drivers, thus creating a total of eight drivers. The additional drivers in the SEP rubric are professional culture and culturally relevant pedagogy. Culturally relevant pedagogy was added as a driver in order to emphasize the important role a multicultural approach to science education has in teaching racial, ethnic, and linguistically diverse students with equity. Incorporating professional culture as a driver in the SEP rubric is important because just as school culture it “influence[s] the creation of social ties and relationship and is likely the critical element enhancing or curtailing effective teaching and successful student outcomes” (Borman, 2005, p. 7).

The first step was to determine the eight drivers of the SEP rubric. In order to characterize factors of systemic academic improvement in science education programs, I analyzed the NSF Six-Driver Model simultaneously with other scholarly literature on science education reform (NSF, 2000 & Borman, 2005). In the first stage, I conducted content analysis by identifying key words and phrases within Borman’s (2005) written descriptions for each driver (see p. 6). According to Hsieh and Shannon (2005), content analysis is “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (p. 1278). Identified words and phrases were used to develop a conceptual illustration or theme for each driver represented in the SEP rubric.

In the second stage of analysis, I identified categories for the SEP rubric. Questions from the Science Program Interview (SPI) were reviewed repeatedly and content analysis was applied in order to recognize themes coinciding with the eight existing SEP drivers. Creswell (2007) describes the process as “[taking] the significant statements and then group[ing] them into larger units of information, called ‘meaning units’ or themes” (p. 159). A total of thirty themes were identified which align contextually with the SEP drivers. The emerged themes are best described as educational administrative aspects of a public school science program.

In the third stage of analysis, I identified indicators of the SEP rubric. The SPI instrument was used to collect qualitative data from science teacher liaisons at each high achieving high school in the study. Interview responses were audio recorded and transcribed verbatim to conduct content analysis. The content analysis process involved identifying and highlighting specific words or phrases that aligned with each category theme. I also wrote brief notes along the margins of each transcript to capture explanations of instructional practices and procedures corresponding with each category and their respective driver within the SEP rubric. A list of numerous instructional practices and procedures gathered from each science teacher liaison was then generated. This list represents operational strategies related to implementing equity pedagogy. A comprehensive list of 127 indicators were identified which align with both categories and drivers within the SEP rubric. (See Appendix C).

Results

Results of the study show indicators of a comprehensive SEP rubric. Together, 127 indicators, thirty categories, and eight SEP drivers form a model framing equitable teaching and learning practices associated with both high science achievement and college ready performance (see Table 2.4). Figure 2.5 illustrates the process that guided development of the SEP rubric.

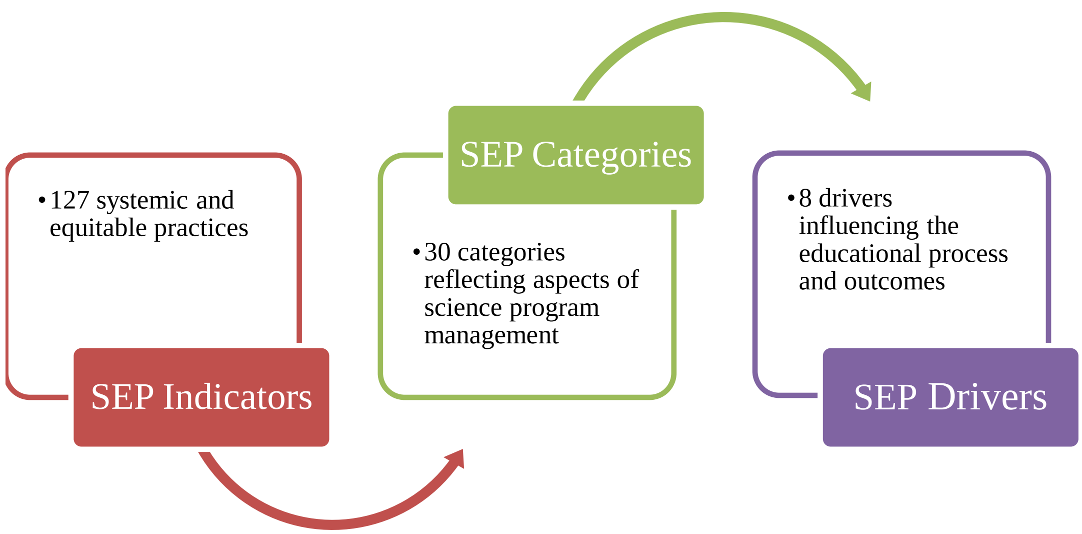

Figure 2.5. SEP Process Map. Process schematic of SEP indicators, categories, and drivers.

Indicators within the SEP rubric are specific practices gathered from verbatim interview transcripts with science liaisons. Based on the data from the SPI, each high school science program in the study often differed in their methods of implementing specific practices.

Table 2.4

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data
		Conduct classroom observations with follow-up curriculum-focused discussions
		Conduct collaborative curriculum and instructional planning meetings
		Develop and use higher level questioning strategies
		Review and revise instructional strategies based on formative and summative assessments
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)
		Evaluate student work products
		Post learning objective aligned with curriculum goals
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards
	Basis of Selecting Instructional Materials	Align with school district science curriculum
		Consider needs of the science program
		Solicit science teacher feedback on instructional resources
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)
Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods
		Promote inquiry through workshops and various professional development opportunities
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies
		Facilitate student-led investigation and problem solving
		Use of questioning strategies aligned with Bloom’s Taxonomy
		Incorporate hands-on laboratory activities
		Model real-life inquiry science learning
	History and Nature of Science Emphasis	Conduct field studies (e.g., parks and outside areas around campus)
		Communicate using lecture/discussion strategies
		Utilize a cross disciplinary approach to teaching science
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)
		Participate in university sponsored school science programs
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)

Table 2.4 Continued

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district
		Allocate budget to science department through campus administration
		Designate within end of year campus improvement planning
		Obtain loaned equipment from regional education service centers
		Lead teacher requisitions for materials and resources
	Instructional	Designate a convenient and central locations on campus
		Encourage teachers to share materials among colleagues
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools
		Includes sharing pedagogical methods (e.g., instructional strategies)
		Includes sharing curricular tools (e.g., books, quizzes, and tests)
		Includes mentoring and classroom visits
		Includes sharing student assessment results
Stakeholder Support	School Level	Collaborate between science department and campus administrators
		Support from science department chairperson
		Support from science content specific lead teacher
		Support from science teachers
	District Level	Support from science content specialist
		Support from district level administrator in curriculum and instruction
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials
		Communicate departmental needs via email or verbal communication
		Communicate regarding professional development opportunities
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)
Professional Development (PD)	Within School/Distric	Access to pre-determined PD aligning with district science curriculum
		Offer PD during professional learning community meetings
		Sponsor on-campus PD opportunities in science
	Outside School/District	Attend PD offered through regional education service centers
		Attend science education conferences (e.g., CAST)
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning
		Review generated data reports of students' academic background profile
		Develop systematized instructional improvement processes
		Practice self-reflective questioning of teaching progress and practices
	Teacher Individuality	Encourage greatly within the science program
		Align with curriculum standards
		Reflect best practices
	Science Program Strength	Nurture connection with students
		Increase cohesion and mutual respect among professionals
		Support collegiality
		Develop strong classroom management
		Promote caring for student needs
		Promote horizontal and vertical curriculum alignment
		Maintain high teacher retention
	Shared Practices Among Teachers	Share materials and resources willingly
		Encourage PD attendance and participation
		Analyze data of student performance results
		Prepare for benchmark exams
		Communicate frequently
		Care for each other
		Seek to know students
		Meet frequently and willingly
	Professional Philosophy	Maintain high expectation for student achievement
		Promote collaboration in the classroom and among classroom teachers
		Prioritize students learning and success at the first order of business
		Engage staff in analyzing data for achievement
		Give frequent praise and expressions of gratitude to teachers
	Special Science Program Attribute	Be passionate about teaching science
		Maintain a professional attitude
		Employ student-centered approaches in teaching science
		Operate as a team

Table 2.4 Continued

Culturally Responsive Teaching	Reform-based Instructional Practices	Facilitate inquiry-based teaching	
		Facilitate hands-on instruction	
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	
		Integrate technology during science learning	
	Career Plan Developmen	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	
		Integrate social issues topics into classroom discussions	
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	
		Encourage student participation in advance placement courses	
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

However, despite this variation among science programs, the essence of their teaching and learning practices remained the same. Evidence of this is observed in Table 2.5.

For example, science liasions were questioned by PRISE researchers concerning the use of reflective curriculum practices within their science program. In Table 2.5, excerpts from interview transcripts show variations in the described practices of each science programs. I believe these differences highlight something important about approaching reflective practice in successful science programs involving culturally diverse students.

Science programs in these schools collectively illustrate there are at least five important elements to consider when teaching science in cultrually diverse school settings. Reflective practice must be student-centered, curriculum-focused, incorporate achievement data, involve verbal conversations and collaboration (e.g. observing colleagues in other classroom, modeling instruction and meeting with other teachers in the science program). Most evident among these science programs is the notion that reflective practice is an intentional process in their day-to-day effort of serving culturally diverse students in their schools.

Table 2.5

Excerpt of Reflective Curriculum Practices in Science Programs

Science Program Interview #10a	How does the science program provide teachers with a method for reflecting on their "teaching experiences"?
School No. 51	"We do, but I think that the problem is that we're so busy that we don't take the time…as far as every individual teachers, there might be some teachers who do reflect, but as a whole, I don't think we have the time to reflect."
School No. 52	"We have a program…where during our planning periods…we go and watch other teachers…in different curriculums than ours uh, to try to get ideas…"
School No. 53	"Uhhhm we do encourage (science teachers) to go and observe each other, we do encourage them to go in and [that is] the reason why we have them all together is that they can actually talk to each other and say, 'You know what this is that I am doing and it's not working for me, what do you recommend?'"
School No. 54	"Absolutely, that's part of our instructional improvement process, we would call it I.I.P. for short, Instructional Improvement. It has a series of steps, and um, one of these steps at the end is data analysis of the unit tests and, then the next step within that is reflection over, um, well how did my students do, like it's this form…look at data based on sub pops".
School No. 55	"Yeah, we have, you know that really we are time strapped. All the teachers are time strapped and so it's kind of a adjusting on the fly, it's constant reflection that's going on and getting those conversations, we talk about it. As far again, we don't have a formal process of writing it down and going through the formal thing".
School No. 56	"For reflecting on teaching. We're starting that. We're starting that on the collaborative planning sessions. We're trying to actually, after the planning session and if we get through a whole planning session, the teacher [goes] and teach what they've planned, then we're reflecting".
School No. 57	"Other than on their own…when I feel we do that is when our teams meet. I always feel that's one of the most important things we do. I really think, even as a teacher, when I'm done with a unit, and I'm doing that test, that's where I have the ability to reflect personally."
School No. 58	"…during our collaboration, um, where we would bring in student work and we would, em, evaluate the student work…I'll tell you we're a da- we're a data-driven campus. We look at the data to- I mean, in the first semester…"
School No. 60	"We have to make sure that our objectives are clearly posted on the board. We also are given, or instructed to give some type of measurement on how our instruction can be measured in the classroom. We implement it on a daily basis."
School No. 62	"Um and so the teachers get together and the teams meet and discuss what they're going to do pretty much and they go okay we know okay the first week we're going to have to do this anyhow so here we go. Um and then when the scope and sequence comes out they'll get together and talk about it."

Note. Transcription of verbal response during Science Program Interview involving the science liasion(s).

Summary

Analysis also reveals high school science programs engage in formal and informal approaches to implement teaching and learning practices identified as indicators within the SEP rubric. Formal approaches are characterized as official and structured professional experiences within the science program. These experiences typically possess clearly defined expectations, occur at designated times and locations, and have definite roles. Informal approaches, on the other hand, are often engaged in spontaneously and without significant prior planning. These approaches do not typically follow a prescribed plan of action for professional practices within the science program. A science program's use of either formal or informal approaches varies according to the size of the high school/science program, the availability of resources (i.e., fiscal, human, material), and the expectations of the campus principal or district.

Indicators within a comprehensive SEP rubric possess action verbs at the beginning of each explanation because they coincides with the behaviors and practices described by science teacher liaisons during the Science Program Interview. The aspect of this study which underscores science teacher behavior relates to teacher efficacy. It is widely recognized that teacher ability influences student performance. In this case, high science achievement and college ready performance is likely the result of teacher beliefs concerning their abilities to meeting the learning needs of diverse student populations.

Teacher efficacy runs along a scale ranging from high to low. Teachers with high efficacy are confident in their abilities to influence positive change in students' learning despite conditions of the learning environment. Additionally, high efficacy teachers maintain high expectations for students to meet academic standards and deliver engaging instruction resulting in authentic learning experiences in the classroom. In contrast, teachers with low efficacy are often reluctant to overcome challenges associated with teaching, particularly with those of diverse student populations. Teachers with low efficacy give multiple reasons as to why students are not meeting academic standards, provide instruction which is not student-centered, and often fail to engage students in critical thinking. Low efficacy teachers have very low expectations for student achievement.

The indicators within the SEP rubric are action-oriented in order to underscore behaviors that are “intended or enacted attempts” to facilitate quality science education for all students (Provenzo, 2009, p.3). Provenzo states “as a verb, ‘reform’ refers to intended or enacted attempts to correct an identified problem…its’ goal is to realize deep, systemic, and sustained restructuring” (2009, p.3). Under the SEP framework, the indicators described within these ten high achieving science programs capture the essence of systemic practices influencing equitable outcomes in the science education of culturally diverse student groups.

CHAPTER III

ASSESSMENT OF SYSTEMIC EQUITY PEDAGOGY: SCORING INDICATORS OF HIGH SCIENCE ACHIEVEMENT AND COLLEGE READINESS

Science programs marked by high science achievement and college readiness in high schools of proportionally large, culturally diverse student populations may appear as an anomaly in 21st Century public education. Schools achieving this significant status are few. This is especially true in the state of Texas (Stuessy & Bozeman, 2011). According to Stuessy and Bozeman (2011), out of 1,370 high schools, only 28 high schools having high, culturally diverse student populations are identified as achieving at high levels in terms of student science education and preparation for college. Examination conducted by the Policy Research in Science Education (PRISE) – II Research Group at Texas A&M University studied a sample of ten high schools. This study provides greater understanding for characteristics of teaching and learning practices associated with the science programs within these schools. Research studies that examine these programs help relieve the mystery surrounding schools otherwise seen as unlikely institutions of outstanding academic success (see Darling-Hammond & Friedlaender, 2007; Schwartz, 2010; and Stuessy & Bozeman, 2011).

According to Darling-Hammond and Friedlaender (2007, p. viii), “design features, which are mutually reinforcing” and act cohesively through instructional practices, academic programs, and educational policies support the success of schools to meet the needs of all students. Characteristics that associate with high academic achievement in science can be identified, by studying these science programs. In addition, these characteristics contribute to design of a model based on indicators of systemic and equitable teaching and learning practices. By assessing these indicators within and across the ten high schools taking part in this study, new knowledge is formed about "best practices" relevant to science programs within other high schools of similar features.

Definition of Equity Pedagogy

Achieving equitable teaching and learning experiences for all students within a learning institution is difficult (Kahle, 1998). Pinpointing specific practices shared by different (i.e., geography, socioeconomic status, and student population) schools within the same state are a greater challenge. Assessing indicators of systemic and equitable teaching and learning practices associated with high science achievement and college readiness calls for an understanding of equity pedagogy.

The notion of systemic and equitable teaching and learning practices is rooted in equity pedagogy. Referred to here as systemic equity pedagogy (SEP), the term describes a systems-approach to carrying out equity pedagogy within a school's science instructional program. The definition of equity pedagogy developed by Banks (1995) is used in this chapter and forms the basis for understanding SEP. Banks (1995) define equity pedagogy as "teaching strategies and classroom environments that help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function effectively within, and help create and perpetuate, a just, humane, and democratic society" (p. 152). From another perspective, equity pedagogy, as described by Zirkel (2008), establishes "pedagogical innovations" to provide equitable learning experiences for all students by challenging conditions within the educational environment. Zirkel (2008) further states, “One focus of equity pedagogies is to develop and use teaching techniques and methods that can address different learning styles and to develop pedagogical approaches that facilitate the educational achievement of lower performing students” (p. 1157). Definitions provided by both Banks and Zirkel avoid restricting equity pedagogy to a particular setting, such as occurring only within the classroom. In addition, these two definitions for equity pedagogy do not specify who among an instructional staff might encourage implementation of equity pedagogy. Thus, administrative and instructional staff members may contribute to the implementation of equitable pedagogy across a complete educational program or within a single classroom.

The two definitions provided by Banks and Zirkel make clear that many functional mechanisms in the form of “strategies” (Banks, 1995) or “techniques and methods” (Zirkel, 2008) supporting student learning and performance are the parts necessary for equity pedagogy. In SEP, therefore, factors and indicators are fundamental for promoting equitable teaching and learning, which moves beyond the scope of the classroom to incorporate the educational programs and school-level practices within schools.

Systemic Equity Pedagogy

In early 2000, assessing the impact of systemic reforms directed the National Science Foundation (NSF) to develop six “process and outcome reform drivers”. Additionally, these drivers collectively make up the NSF’s Six-Driver Model (2000) that represents critical reform-based policies (or drivers) applicable for surveying the transformation of science education programs within complex educational organizations, including schools (Borman, 2005). See Table 2.2 for the NSF Six-Driver Model (2000). Major parts separate each driver in the NSF model. Before the development of the NSF model, Borman (2005) suggests no other framework existed for evaluating different instructional approaches and programs aimed towards systemic improvements in science education.

This study develops a new model referred to here as the systemic equity pedagogy (SEP) model (see Figure 2.1). The SEP model consists of eight drivers making up an adapted and extended version of the NSF's Six-Driver Model (2000). The SEP model differs from the NSF model in three ways. First, the SEP model is less strict in terms of curriculum by assessing academic programs within schools not actively involved in systemic reform. Second, this version is more specific in terms of school context by measuring educational programs because of ideological, operational and pedagogical indicators identified within successful science programs serving proportionally large, culturally diverse student populations. Third, the SEP model is more comprehensive by evaluating professional development, professional culture, and culturally responsive teaching as added drivers. The SEP model entails reform-based drivers strategic for surveying school program-level associations for equitable teaching and learning practices in science education. Setting up reform-based policies, like those in NSF's Six-Driver Model (2000), are thought to result in different practices, strategies, and approaches that school administrators and teachers use to meet needs of current education policy. In contrast, equitable teaching and learning practices documented in the SEP model and identified in these successful schools can build the knowledge base by which sound strategies are developed in culturally diverse science programs.

According to the NSF Six-Driver Model (2000), many drivers influence systemic and equitable education in science. The SEP used in this study follows the same logic. As explained in Figure 2.1, the eight drivers in the SEP model include (1) standards-based curriculum and instructional materials, (2) reform-based policies in science, (3) convergence of resources into science programs, (4) stakeholder support, (5) student achievement indicators, (6) culturally responsive teaching, (7) professional culture and (8) culturally responsive teaching. In this study, I rate ten science programs and their science teachers' practices according to a rubric consisting of the eight SEP drivers.

Rationale

The rationale for this study is twofold. First, science programs are integral to the education of culturally diverse student populations. Second, teachers within science programs are aware of the equity pedagogies occurring in their classrooms and the classrooms of their program colleagues. This study will provide guidance into the responsibility of drivers, categories, and indicators of SEP on the science achievement and college readiness of culturally diverse students in high school science programs.

Problem Statement

Specific policy drivers influence the process of systemic improvement in schools experiencing academic challenges in science education (Hewson, Kahle, Scantlebury, & Davies, 2001; Kahle, 1998). According to Borman (2005), policy drivers within effective science education reform help to promote "prescribed approaches [that align with the] NSF developed a model of systemic reform" (p. 5). Pedagogical approaches that align with the NSF model may vary from school to school as illustrated in the complete SEP rubric (see Appendix C). However, one issue remain, these equitable teaching and learning practices have not been identified across all highly successful schools in the sample. This study cannot find them as "best practices" associated with high science achievement and college readiness for culturally diverse students.

Performance results that successful science programs experience is not limited to high science achievement scores on standardized tests. Results in programs targeted by systemic reform in science reveal other results, such as promoting equitable teaching practices, students meeting curriculum standards, a decrease in the achievement gap, and student readiness for college (Borman, 2005; Edmonds, 1979; and Hammond, 2006). Assessment of SEP among the programs in the current study will provide an understanding of what extent program-level practices contribute to results of high science achievement and college readiness for culturally diverse students.

Measuring Equity in Science Instruction

Analysis of two urban middle school science programs by Kahle (1998) and Hewson (2003) identified certain conditions known to contribute to equitable education in science, especially among culturally diverse student populations. Kahle is credited for developing the equity metric, a tool used in the analysis for this study. The Wisconsin Center for Education Research (WCER, 2003) points out, "The metric delineates the conditions within classrooms, schools, and districts that define equity in science education" (p. 2). In four categories, Kahle's equity metric explains various indicators of equity. Those categories are: (1) student access to quality education, (2) student retention within the system and within mathematics and science, (3) student achievement because of participation in the system, and (4) overall indicators (Kahle, 1998 & WCER, 2003, p. 2). Indicators of equity were identified through a process that involved synthesis of many sources including public databases (i.e., National Education Longitudinal Study of 1988, High School and Beyond, and Trends in International Mathematics and Science Study), National Science Foundation indicators, research literature and the analysis of systemic reform initiatives (Kahle, 1998). Indicators that were prominent in school systems were assigned to appropriate categories in the equity metric. Kahle (1998) states the purpose of developing the equity metric was "to identify indicators that:

- are sensitive to diversity among groups
- are used to inform action, not only to define the present state;
- are flexible, because not all metrics are relevant to all parts of the system;
- distinguish between opportunity, accessibility, and participation;
- are directed toward leverage points in the system; and
- are feasible to use (i.e., affordable) (p. 10).

Therefore, contrary to conventional assumptions, a single characteristic, such as high performance results on tests or other assessments, does not guarantee the existence of equity in schools. Kahle suggests the equity metric "moves] beyond a statistical analysis of student achievement as the primary measure of equity in a system" (Kahle, 1998, p. 10). Knowledge of this point serves to reshapes perspectives on what to recognize, and even evaluate as evidence of equity in schools. Therefore, qualitative evidence is equally valuable when considering signs of equity. Kahle's equity metric explains assessing progress towards equity, especially in science, occurs by operationalizing or defining ideas and variables associated with equitable teaching and learning.

Darling-Hammond and Friedlaender (2007) arrive at a similar conclusion about qualitative evidence pointing to equity in schools. In their case study analysis involving five academically successful high schools serving predominately low-income and diverse student populations, they indicate high expectations, access to rigorous coursework, teachers using culturally relevant pedagogy to connect with students, and authentic learning experience as chief qualities of equity (Darling-Hammond & Friedlaender, 2007). Additionally, the use of multiple authentic assessments and qualities such as "trusting and personal relationships between and among students and staff and [demonstrating] a commitment to social and racial justice" contribute to an equitable learning environment in science for all students (Darling-Hammond & Friedlaender, 2007, p. iii).

Equity in Culturally Diverse High Schools

For the *High Schools for Equity* policy brief, Darling-Hammond and Friedlaender (2007) conducted a statewide study of high achieving urban high schools in the state of California. Similar to the PRISE research cited earlier this study identified high achieving schools using multiple selection criteria including both graduation and college entrances rates. The use of graduation and college entrance rates are an essential distinction to highlight due to implications of college readiness. Based on parameters of proportionally large culturally diverse student population, school setting, socioeconomic status, and achievement; a population of three hundred sixty high schools was considered for participation in the study. However, the researchers chose five schools in order to retain a small sample for qualitative analysis (Darling-Hammond and Friedlaender, 2007).

The purpose of the study was to describe the practices, design features, and performance results of five urban high schools successful at preparing predominately low-income students of color for college. Additionally, the study served to provide policy recommendations, which develop, uphold, or change schools into equitable and just learning environments for all students (Darling-Hammond and Friedlaender, 2007). Darling-Hammond and Friedlaender make clear that of the various practices carried out in these schools, these practice are mutually align and rooted in a central belief that all students have the intellectual capital and ability to go to college.

In their case study analysis, Darling-Hammond and Friedlaender (2007) delved into specific features at these high schools, which contributed to equity and student achievement throughout their educational program. Similar to the indicators listed in the SEP rubric, these specific features were categorized as personalization, rigorous and relevant instruction, and professional learning and collaboration (Darling-Hammond & Friedlaender, 2007). Table 3.1 gives a list of featured practices identified by Darling-Hammond and Friedlaender (2007).

Table 3.1

High School Design Features for Equity

Personalization	Rigorous and Relevant Instruction	Professional Learning and Collaboration
1. Small learning environments	1. College preparatory curriculum	1. Allocate time for teachers to work collaboratively
2. Continuous, long-term relationship between students and adults	2. Career preparations though internship, coursework, and other real-world experiences	2. Professional development time built into the school year
3. Advisory system that organizes support in counseling, academics, and family connections	3. Authentic learning experiences through performance assessments	3. Weekly joint-planning time
4. Block schedules	4. Interventions involving culturally relevant instructional support and scaffolding	4. Faculty involvement in determining and enacting shared goals
5. Co-teaching model	5. Curriculum about students' communities and culture	5. Democratic decision making involving faculty, parents, and students
	6. Parental outreach efforts	
	7. Partnerships with local community groups, industries, and higher education	

Note. Source High Schools for Equity Policy Brief, p. viii.

Research Questions

Two research questions guide the work in this study. How do highly successful science programs in culturally diverse high schools score (i.e., average mean, standard deviation, range, and frequency count) on the SEP rubric? What are the frequencies of occurrence for practices in the SEP rubric?

Methods

Within the Methods section, the following are discussed: Research Design, Research Context, Selection of Participants, Data Collection and Data Analysis. First, I will discuss details concerning the research design and context for studying successful high school science programs involving culturally diverse students. Second, I will explain my strategy for selecting of participants and collecting and analyzing data. In conclusion, I will present research findings and discussion for this chapter.

Research Design

This study involves the use of mixed-methods research methodologies. The PRISE-II Research Group, located in the College of Education and Human Development at Texas A&M University, collected data in 10 high schools to inform the development of the SEP rubric. The participants in the study were science teacher liaisons and science teachers within high schools selected by purposeful sampling. The school principal at each of the ten schools identified the science liaison and science teachers.

Research Context

In Texas, a few public high schools with proportionately large, culturally diverse student populations demonstrate success in producing students with high achievement in science and college readiness (Stuessy & Bozeman, 2011). According to the Policy Research in Science Education (PRISE-II) research group at Texas A&M University, about 2% of these high schools (i.e., schools with student populations ≥ 75% consisting of African American, Latino, and/or Native American) in Texas "[are] identified as being well prepared in science and ready for college" (Stuessy and Bozeman, 2010). That translates into only 28 high schools out of 1,370 total high schools within the state. This is alarming evidence of present and inequitable science achievement. Additionally, this signals concern of an existing achievement gap in many Texas public high schools (Stuessy and Bozeman, 2010).

Selection of Participants

The PRISE-II Research Group selectively chose ten of the 28 Texas high schools identified as having large, culturally diverse student populations that were also successful in science achievement and college readiness (Stuessy and Bozeman, 2011). Formal letters, telephone contacts, and campus visits describe efforts used to request the participation of each campus principal in the ten high schools. After meeting face-to-face with each high school principal, we gained permission to conduct this study with the science liaisons and science teachers in each school. Ten science liaisons and 138 science teachers were participants in the study.

Data Collection

Qualitative and quantitative data was collected for use in this study. Qualitative data describing school science program was collected using a structured interview. Quantitative data describing science teacher practices was collected using survey response data. All data was collected during the spring of 2012 and archived using standard practices.

Qualitative Data Collection

The PRISE Research team conducted a single 60-minute structured interview session with science teacher liaisons at the ten high schools. Each one-on-one interview was recorded using a digital audio recorder, and field notes were taken. The instrument used to collect data was a 29-item Science Program Interview (SPI) instrument (see Appendix A for the Science Program Interview). The SPI focused on four elements within a high school science program. These elements include the organization, curriculum, instructional priorities, and vision of the science program (Stuessy & Bozeman, 2011). The purpose was to gather information that described specific equitable teaching and learning practices (or indicators) within high achieving high school science programs. Additionally, the interviews provided perspectives of the instructional practices used to meet the needs of the culturally diverse student populations. The science teacher liaisons' interpretations are used to informs the list of indicators within the SEP rubric. Table 3.2 illustrates SEP drivers that correspond to the SPI instrument.

Table 3.2

Corresponding SEP Drivers to Science Program Interview Items

Driver	Systemic Equity Pedagogy	Science Program Interview Items
1	Standard-based Curriculum and Instructional Materials	10a, 11, 12, 13
2	Reform-based Policies in Science	14a, 14b, 14c, 14d, 25
3	Convergence of Resources into Science Programs	11, 13
4	Stakeholder Support	1, 2, 3, 5, 6
5	Professional Development	7a, 7b, 8
6	Professional Culture	10a, 16, 25, 26, 27a, 27b, 28, 29
7	Culturally Responsive Teaching	14a, 18a, 18b, 19a, 19b, 19c, 24
8	Student Achievement Indicators	20, 22

Note. Science program data collected the Science Program Instrument.

Quantitative Data Collection

The Texas Poll for Secondary Science Teachers (TPSST) was utilized to gather information from 138 high school science teachers within the study (Stuessy & Bozeman, 2011, See Appendix B). The TPSST is a thirty-six item Likert scale instrument, which assesses science teachers' level of participation in professional activities and attitude about their work environment (Stuessy & Bozeman, 2011). Several questions related to teacher use of equitable teaching and learning practices in science are embedded into the TPSST. Table 3.2 also details the list of embedded TPSST items associated with equitable teaching and learning strategies.

Data Analysis

I obtained data for this study from three archived data sources: electronic audio recordings, interview transcripts, and a teacher survey database. Two stages marked the process of analyzing the research data. In the first stage of analysis, I conducted a comprehensive content analysis of each SPI audio recording. This process involved repeated and careful listening of each SPI audio recording while also using the SEP rubric (see Appendix C) to check-off concrete and/or inferred educational practices indicated by each science liaison during the interview. This process of evaluation occurred for all schools (see Appendix D). In the second stage, I made brief notes of pertinent nuances that distinguished the science programs' approach to certain teaching practices.

I conducted data analysis using both quantitative and qualitative approaches. Embedded TPSST items relating to equitable science teaching strategies were compiled and analyzed using Likert scale responses. This quantitative analysis resulted in calculating mean and standard deviation values for each high school science program. The Science Teacher Equity Score (STES) is derived from the mean value in this analysis. A linear form of representation was considered for the equity scores data to describe the relationship of data points to one another and explain how science teachers varied in their views. As an added effort to highlight any variation, equity score differences were also figured.

Findings

Figure 3.1 shows results of SEP indicators identified among the high school science programs selected for this mixed-method analysis. These scores represent an assessment of teaching and learning practices in the SEP rubric as explained by the science teacher liaisons during each science program interview. The Science Program Equity Score (SPES) for each high school science program ranges from 45 points to 71 points. The median, a value separating all scores in half, is 69.1. Science programs above the median are SP 53, SP 54, SP 57, SP 58, and SP 62. Further, science programs below the median are SP 51, SP 52, SP 55, SP 56, and SP 60. Science program relationship to the median value suggests the extent to which each program maintains like and differing practices on the SEP rubric. This observation is necessary in order to understand the influence of certain indicators within each driver.

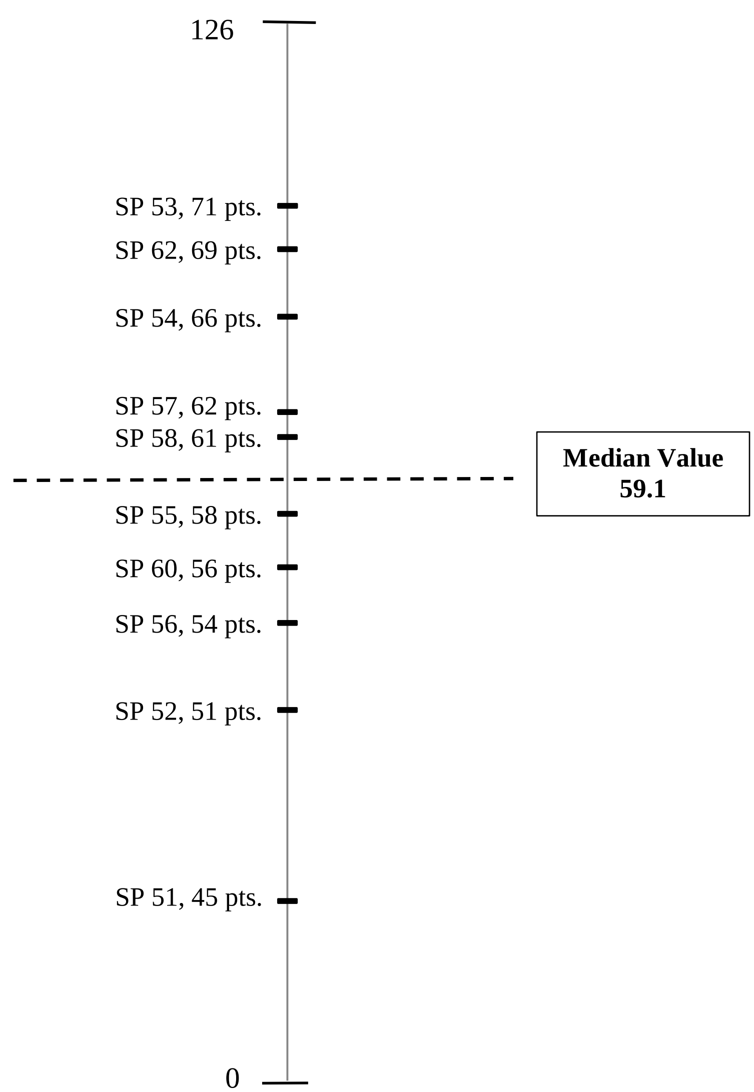

Figure 3.1. Science Program Equity Scores (SPES). Results based on SEP rubric analysis of science liaisons responses using the Science Program Interview instrument.

As Banks' definition of equity pedagogy describes, these high school science programs demonstrate evidence of numerous "teaching strategies" and culturally sensitive "classroom environments" to support student success in science. Together these components work in order to "help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function" successfully in a democratic society (Banks, 1995, p. 152), which today means preparedness for college or other postsecondary education. Therefore, this implies systemic reform drivers are associated with high science achievement and college readiness through the implementation of a variety of equitable teaching and learning practices in the SEP rubric.

The SPES also reveals pedagogical and non-pedagogical practices are necessary to support the development and implementation of teaching strategies and culturally responsive learning environments. Table 3.3 provides a list of pedagogical and non-pedagogical practices as SEP indicators by their frequency of occurrence across all science programs. Results show both types of practices are conducive to the promotion of equitable high school science programs. Realization of this phenomenon emanated through observing several non-pedagogical practices science liaisons' often mentioned in describing how their science programs operated. The SEP rubric incorporate these practices as indicators because they were identified by science liaisons as actions to support the success of their science programs. Pedagogical and non-pedagogical practices are embedded into the daily routines of the science program faculty and campus leaders at these high schools.

Table 3.3

SEP Indicator Frequency by Mean Score

SEP Rubric Indicators	Mean score (n=10)
Communicate departmental needs via email or verbal communication (Driver 4, NP) Share materials and resources willingly (Driver 7, NP) Analyze post-test data (Driver 1, NP)	1.00
Conduct collaborative curriculum and instructional planning meetings (Driver 1, P) Incorporate Texas Essential Knowledge and Skills (TEKS) curriculum standards (Driver 1, P) Select instructional materials by considering the needs of the science programs (Driver 1, NP) Use technological tools (Driver 1, P) Use non-technological tools (Driver 1, P) Use scientific hands-on resources (Driver 1, P) Incorporate hands-on laboratory activities (Driver 1, P) Stakeholder support for the science department chairperson (Driver 4, NP) Facilitate science learning within a laboratory (Driver 8, P) Use periodic benchmark school district assessments (Driver 5, NP) Establish a balanced process for making decision (Driver 4, NP)	.90

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Participate in science oriented student organizations and clubs (Driver 8, NP) Allocate budget to the science department through campus administration (Driver 3, NP) Facilitate hands-on instruction (Driver 8, P) Provide advance-placement courses (Driver 8, NP) Collaborate between science department and campus administrators (Driver 3, NP) Engage in collaborative instructional planning (Driver 7, NP) Support collegiality (Driver 7, NP) Meet frequently and willingly (Driver 7, NP) Integrate social issue topics into classroom discussion (Driver 8, P)	.80
Participate in science competitions and fairs (Driver 2, NP) Designate a convenient and central location for materials (Driver 3, NP) Support from lead teachers in other science content areas (Driver 4, NP) Support from science teachers within the department (Driver 4, NP) Attend PD offered through regional education service centers (Driver 6, NP) Modify science lessons (Driver 8, P) Attend science education conferences (Driver 6, NP) Communicate frequently (Driver 7, NP) Facilitate inquiry-based teaching (Driver 8, P) Use real-life issues related to science (Driver 8, P) Encourage student participation in advance-placement courses (Driver 8, NP)	.70

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Review and revise instructional strategies based on formative and summative assessments (Drive 1, P) Promote inquiry through workshops and various professional development opportunities (Driver 2, P) Lead science teacher requisition for materials and resources (Driver 3, NP) Shares pedagogical methods (e.g., instructional strategies) (Driver 3, P) Communicate regarding professional development opportunities (Driver 4, NP) Practice self-reflective questioning of teaching progress and practices (Driver 7, P) Align instructional resources and materials with curriculum standards (Driver 1, P) Promote caring for students (Driver 7, NP) Promote collaboration in the classroom and among classroom science teachers (Driver 7, P) Increase positive student-teacher rapport (Driver 8, NP)	.60
Conduct classroom observations with follow-up curriculum-focused discussions (Driver 1, P) Share curricular tools and student assessment results as well as mentoring and classroom visits (Driver 3, NP) Offer professional development during professional learning community meetings (Driver 6, NP) Encourage teacher individuality within science program; especially to reflect best practices (Driver 7, NP) Encourage professional development attendance and participation (Driver 7, NP)	.50

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Integrate technology during science learning (Driver 8, P)	
Tailor instruction to student personal interests (Driver 8, P)	
Employ differentiated instruction (Driver 8, P)	
Use in-state released standardized assessments (Driver 5, NP)	
Align instructional material selection with the school district science curriculum (Driver 1, NP)	
Solicit science teacher feedback on instructional resources (Driver 1, NP)	
Use questioning strategies aligned with Bloom's Taxonomy to facilitate inquiry-based teaching (Driver 2, P)	
Provisions of instructional materials cared for by the school district (Driver 3, NP)	
Support from district science content specialists (Driver 4, NP)	
Provide input to campus administrators on issues effecting supplies, lab equipment and in-class materials (Driver 4, NP)	.40
Sponsor on-campus professional development opportunities in science (Driver 6, NP)	
Review generated data reports of students' academic profile (Driver 7, NP)	
Develop systematized instructional improvement processes (Driver 7, NP)	
Increase cohesion and mutual respect among professionals (Driver 7, NP)	
Care for each other and maintain a professional attitude (Driver 7, NP)	
Prioritize student learning and success as the first order of business (Driver 7, NP)	
Engage staff in analyzing data for achievement (Driver 7, NP)	
Facilitate hands-on instruction as reform-based instructional practices in science (Driver 8, P)	
Link science content to related careers in science (Driver 8, P)	
Arrange classroom visits by professionals in science-related fields (Driver 8, NP)	
Employ vocabulary enrichment activities (Driver 8, P)	

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Encourage inquiry teaching as an alternative to direct teaching methods (Driver 2, P) Use lecture and discussion strategies to teach the history and nature of science (Driver 2, P) Use interdisciplinary approaches to teach the history and nature of science (Driver 2, P) Participate in career days (e.g., present jobs in science related fields) (Driver 2, P) Encourage teachers to share materials among colleagues (Driver 3, NP) Access to pre-determined professional development aligned with the science curriculum of the school district (Driver 6, P) Nurture connection with students (Driver 7, NP) Promote horizontal and vertical curriculum alignment (Driver 7, P) Prepare benchmark exams; Use pre- and post- unit assessments (Driver 7, P) Maintain high expectation for student achievement (Driver 7, NP) Be passionate about teaching science (Driver 7, NP) Employ student-centered approaches in teaching science (Driver 7, P) Operate as a cohesive team (Driver 7, NP) Facilitate student led in-class demonstrations (Driver 8, P) Integrate social issue topics into the science curriculum (Driver 8, P) Deliver science instruction for English as a Second Language (ESL) students (Driver 8, P)	.30

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Engage in self-reflective questions following classroom instruction (Driver 7, P) Post learning objectives aligned with curriculum goals in science (Driver 1, P) Promote familiarity of national reform documents through dissemination to teacher by campus administrators (Driver 1, NP) Provide in-classroom support to implement inquiry and other reform-based instructional strategies (Driver 2, P) Identify instructional material needs during the end of year campus improvement planning (Driver 3, NP) Obtain loaned equipment from regional education service centers (Driver 3, NP) Establish top-down process for making decisions (Driver 4, NP) Participate in informal social activities (i.e., after work hours gathers at a restaurant) (Driver 6, NP) Maintain high teacher retention (Driver 7, NP) Facilitate cooperative learning as a reform-based instructional practice (Driver 8, P) Develop career plans for students (Driver 8, P) Provide before/after school tutoring opportunities for students (Driver 8, P) Use out-of state released standardized assessments (Driver 5, NP)	.20

Table 3.3 Continued

SEP Rubric Indicators	Mean score (n=10)
Evaluate student work products (Driver 1, P)	
Promote familiarity of national reform documents through dissemination at the school district level curriculum meetings with the science department chairpersons (Driver 1, NP)	
Facilitate student-led investigation and problem solving; Model real-life inquiry science learning (Driver 2, P)	
Conduct field studies (e.g., parks and outside areas around campus) (Driver 2, P)	
Participate in university sponsored science programs; Participate in field trips to science related venues (Driver 2, P)	
Use effective classroom management skills (Driver 7, NP)	
Seek to know students (Driver 7, NP)	.10
Recognize cultural differences among students (Driver 8, NP)	
Give frequent praise and expressions of gratitude to teachers (Driver 7, NP)	
Facilitate project-based learning as a reform-based instructional practice (Driver 8, P)	
Post information on various science careers throughout classrooms (Driver 8, NP)	
Promote student involvement in extracurricular science clubs and organizations (Driver 8, NP)	
Encourage teachers to pursue graduate degrees in order to develop early college programs (Driver 8, NP)	
Employ Response to Intervention (RTI) strategies (Driver 8, P)	
Establish classroom reading stations (Driver 8, P)	

Note. (NP) non-pedagogical practices, (P) pedagogical practices.

All science programs in the study pursue implementation of SEP indicators differently. This variation in approach may be the result of a combination of different significant characteristics among each high school, such as school setting (i.e., urban, rural, or suburban), school size (i.e., small, medium, or large), number of science teachers in the science program, and school funding for each science program. Findings reveal all science programs share the enactment of two specific SEP indicators. According to Table 3.3, they are: 1) communicate departmental needs via email or verbal communication and 2) share materials and resources willingly. These two indicators are both non-pedagogical practices in the SEP rubric. Attempt to understand why these particular non-pedagogical practices are used by all science programs highlight a critical, yet unexpected attribute noticed by PRISE researchers during their school visits. PRISE researchers arbitrarily describe the school culture at all schools being positive, supportive, and prominently on display as the science, liaisons describe various practices of their science programs. Therefore, the school climate in which SEP indicators are applied may be as useful to highly successful science programs as the practices themselves.

Resonating from the science program interview at each high school was the belief that science program faculty members maintained genuine interest in the success of all students. Therefore, according to the science liaisons' description, needs (i.e., instructional, curricular, student-related or administrative) of the department were regularly communicated to by email or verbally in order to keep other colleagues and campus administrators abreast of the science program's status in helping students learn. Likewise, materials and resources were shared freely within the science program at each high schools in order to ensure each science classroom was equip with the needed tools required for all students to learn science.

In Table 3.4, frequency analysis reveals high school science programs appearing above the median (i.e., SP 53, SP 54, SP 57, SP 58, and SP 62). Science programs in these schools regularly practice nineteen indicators listed in the SEP rubric. Eleven of those indicators describe pedagogical practices while the remaining eight refer to non-pedagogical practices. Pedagogical practices appearing in Table 3.4 are characteristic of those tasks that identify various curricular and instructional responsibilities in these science programs. For example, teaching in science program above the median value line is best characterized as incorporating technological tools, scientific “hands-on” resources, inquiry-based instruction, and laboratory activities. These pedagogical practices are carried-out by faculty in the science program, and they include science curriculum standards based on the Texas Essential Knowledge and Skills.

Non-pedagogical practices are characteristic of those tasks that promote student participation in extra-curricular science activities and programs. Another common non-pedagogical practice shared by science programs above the median value line includes several indicators describing professional collaboration. For example, professional collaboration takes place as faculty in these science programs engage in instructional planning, discuss program needs via email or face-to-face communication, and work with other campus administrators and science department leaders to meet the needs of culturally diverse students enrolled in science courses at their schools.

Table 3.4

Indicators Above the Median Value for Science Program

Common Indicators by Science Programs Appearing Above Median Value Line
Analyze post-test data (Driver 1, P)
Conduct collaborative curriculum and instructional planning meeting (Driver 1, P)
Incorporate the Texas Essential Knowledge and Skills (TEKS) curriculum standards (Driver 1, P)
Select instructional materials on the basis of the TEKS curriculum standards (Driver 1, NP)
Use technological tools (Driver 1, P)
Use non-technological tools (Driver 1, P)
Use scientific hands-on resources (Driver 1, P)
Incorporate hands-on laboratory activities (Driver 2, P)
Participate in science oriented science organizations and clubs (Driver 2, NP)
Participate in science competitions and fairs (Driver 4, NP)
Collaborate between science department and campus administrators (Driver 4, NP)
Support for science department chairperson (Driver 4, NP)
Communicate departmental needs via email or verbal communication (Driver 4, NP)
Engage in collaborative instructional planning (Driver 1, NP)
Share materials and resources willingly (Driver 7, NP)
Analyze data of student performance results (Driver 7, P)
Facilitate inquiry-based teaching (Driver 8, P)
Facilitate hands-on instruction (Driver 8, P)
Facilitate science learning within a laboratory (Driver 8, P)

Note. (NP) non-pedagogical practices, (P) pedagogical practices.

Frequency analysis reveals six common indicators within the SEP rubric for high school science programs scoring below the median line (i.e., SP 51, SP 52, SP 55, SP 56, and SP 60). These six indicators are all non-pedagogical practices. In Table 3.5, common indicators appearing below the median value line for these programs are characteristic of procedural and operational tasks. For example, they include supporting collegiality, professional development attendance, balanced decision-making approaches, instructional material selection procedures and communicating science program needs.

Table 3.5

Indicators Below the Median Value for Science Program

Common Indicators by Science Programs Appearing Below the Median Value Line
Consider needs of the science program for selecting instructional materials (Driver 1, NP)
Communicate departmental needs via email or verbal communication (Driver 4, NP)
Establish a balanced process for making decisions (Driver 4, NP)
Attend professional development offered through regional education service centers (Driver 6, NP)
Support collegiality (Driver 7, NP)
Use periodic benchmark school district assessments (Driver 5, NP)

Note. Non-pedagogical practices (NP).

Indicators Not Fewer Than One-Third of Schools

Not all indicator appearing in the SEP rubric were used in all ten science programs. To recognize specific indicators used by no fewer than one-third of science programs in the study, indicators with average scores of 0.30 and below were eliminated from the first SEP rubric. As a result, forty-four indicators were excluded, and a revised SEP rubric was generated to highlight indicators considered crucial to seven out of ten science programs represented (see Table 3.6). Through this process, the most prevailing indicators were identified, along with specific categories and drivers within the rubric.

Even in a revised SEP rubric, the eight drivers believed to contribute to equitable science teaching and learning is still maintained. This observation may also suggest that the collective combination of indicators in the revised SEP rubric are as critical as the eight drivers assumed to support the systemic infusion of equity into highly diverse high school science programs. SEP Drivers 1, 7, and 8 retains the most indicators among the other drivers within the revised rubric.

Table 3.6

SEP Rubric One-Third of Schools

1. Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data
		Conduct classroom observations with follow-up curriculum-focused discussions
		Conduct classroom observations with follow-up curriculum-focused discussions
		Develop and use higher level questioning strategies
		Review and revise instructional strategies based on formative and summative assessments
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it [instructional activity] work” and “What may I need to change?”)
	National Reform	Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards
	Basis of Selecting Instructional Materials	Align with school district science curriculum
		Consider needs of the science program
		Solicit science teacher feedback on instructional resources
		Select on the basis of Texas Essential Knowledge and Skills (TEKS) curriculum standards
	Instructional Materials & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)
2. Reform-based Policies in Science Education	Inquiry-based Teaching	Promote inquiry through workshops and various professional development opportunities
		Use of questioning strategies aligned with Bloom’s Taxonomy
		Incorporate hands-on laboratory activities
		Model real-life inquiry science learning
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)
	Informal and Extracurricular Science Participation	Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)
3. Convergence of Resources within Science Programs	Instructional Material Provision	Furnish by school district
		Lead teacher requisitions for materials and resources
		Allocate budget to science department through campus administration
	Instructional Material Distribution	Designate a convenient and central locations on campus
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools
		Includes sharing pedagogical methods (e.g., instructional strategies)
		Includes sharing curricular tools (e.g., books, quizzes, and tests)
		Includes mentoring and classroom visits
		Includes sharing student assessment results
4. Stakeholder Support	School Level	Collaborate between science department and campus administrators
		Support from science department chairperson
		Support from science content specific lead teacher
		Support from science teachers
	District Level	Support from science content specialist
		Support from district level administrator in curriculum and instruction
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials
		Communicate departmental needs via email or verbal communication
		Communicate regarding professional development opportunities
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)
5. Student Achievement Indicator	Assessment Usage	Use pre-or post-unit tests
		Use periodic benchmark district assessments
		Use in-state released standardize assessments
6. Professional Development (PD)	Within School / District	Offer PD during professional learning community meetings
		Sponsor on-campus PD opportunities in science
	Outside School / District	Attend PD offered through regional education service centers
		Attend science education conferences (e.g., CAST)

Table 3.6 Continued

7. Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning
		Review generated data reports of students' academic background profile
		Develop systematized instructional improvement processes
	Teacher Individuality	Encourage greatly within the science program
		Align with curriculum standards
		Reflect best practices
	Science Program Strength	Increase cohesion & mutual respect among professionals
		Support collegiality
		Promote caring for student needs
	Shared Practices Among Teachers	Share materials and resources willingly
		Encourage PD attendance and participation
		Analyze data of student performance results
		Communicate frequently
		Care for each other
		Meet frequently and willingly
	Professional Philosophy	Promote collaboration in the classroom and among classroom teachers
		Engage staff in analyzing data for achievement
		Prioritize students learning and success at the first order of business
	Special Science Program Attribute	Maintain a professional attitude

8. Culturally Responsive Teaching	Reform-based Instructional Practices	Facilitate inquiry-based teaching
		Facilitate hands-on instruction
		Facilitate science learning within a laboratory
		Integrate technology during science learning
	Career Plan Development	Link science content to related careers in science
	Promote Personally Relevant Instruction	Seek to understand student interests
		Increase positive student-teacher rapport
	Engage Student Personal Interests	Tailor instruction to student personal interest
		Arrange classroom visits by professional in science-related fields
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)
		Integrate social issue topics into the curriculum
	College Ready Preparation	Provide advanced placement courses
		Encourage student participation in advance placement courses
	Customize Instructional Practices	Employ vocabulary enrichment activities
		Employ differentiated instruction
		Modify science lessons

Note. Table 3.6 represents SEP indicators appearing within 7 out of 10 high school science programs.

Summary

Science teachers in these science programs believe strongly in their ability to enhance learning for all students despite their background characteristics (e.g., race/ethnicity, socioeconomic status, and academic performance). Through careful analysis of audio recording obtained during science program interviews and follow-up discussions with PRISE researchers, science liaisons revealed teachers in their programs expressed the importance of maintaining high expectations for all students.

While an appreciation of high expectations is not enough, science programs in these high schools use different possible resources within their own organization to ensure understanding and academic success occur for all students in science. I think this study has several implications for other science programs challenged with meeting the educational needs of culturally diverse students.

CHAPTER IV

PRACTITIONERS' APPROACH TO SYSTEMIC EQUITY PEDAGOGY: PERCEPTIONS AND PRACTICES OF TEACHERS IN HIGHLY SUCCESSFUL HIGH SCHOOL SCIENCE PROGRAMS IN TEXAS

In many approaches to school reforms involving science education, much attention is apparently on changing instructional practices and policies that build a practitioners' capacity to improve learning for all students (Darling-Hammond and Friedlaender (2007). These efforts are not misguided. However, other efforts to improve science education may be isolated and fragmented unless they include systemic practices oriented toward equity (Atwater, 1999; 2010 & Darling-Hammond and Friedlaender, 2007). For that reason, approaches contributing to systemic and equitable science teaching and learning are central to the process of improving science education in schools (Wisconsin Center for Education Research, 2003). Schools typically engaged in these efforts have a history of most students of color failing to meet their state's academic standards in science (Atwater, 1999). Unfortunately, these are also schools with a significant population of traditionally underserved students of racial, cultural and linguistic diverse backgrounds.

In 2010, the Policy Research Group in Science Education (PRISE) developed a variable related to student outcomes in science. Referred to as the Student Aggregate Science Score (SASS), this variable incorporates performance indicators that the state of Texas uses to assess high school success in science and college readiness (Stuessy and Bozeman, 2010). According to Stuessy and Bozeman, "this variable [is] used to determine the relationships of school support practices and teacher characteristics to positive student outcomes in science”. Within the context of traditionally underserved student populations, SASS may even provide evidence of the extent to which school support services and teacher characteristics influence equitable teaching and learning within science programs.

Science Education in Texas High Schools

In Texas, a disproportionate amount of public high schools with large populations of traditionally underserved students show outstanding performance by meeting academic standards in science and becoming college-ready (Bozeman & Stuessy, 2011). According to the Policy Research in Science Education (PRISE-II) research group at Texas A&M University, approximately 2% of proportionally large culturally diverse high schools (i.e., schools with student populations ≥ 75% consisting of African American, Latino, and/or Native American) in Texas “[are] identified as being well prepared in science and ready for college” (Stuessy and Bozeman, 2010). That translates into only 29 highly successful, most culturally diverse high school science programs of 1,370 comprehensive high schools within the state. This is disturbing evidence of present and inequitable science achievement. Additionally, this signals concern of an existing achievement gap in many Texas high schools (Stuessy and Bozeman, 2010). Conversely, this evidence is also indicative of the appearance of transformative, culturally conscious, and adaptive practices implemented in high schools apart from any structured or institutional reform program. A significant exploit such as high science achievement with college-readiness in a few, but select culturally diverse high schools credits the work towards equity (Darling-Hammond & Friedlaender, 2007 & Kahle, 1998). In order to understand the relationship of high science achievement and college-ready performance with systemic equity pedagogy, this paper examines perceptions and practices of science teachers in the ten high schools involved in the PRISE study.

Transformation in Science Programs

A type of transformation results when educational institutions and core curriculum programs within them are "perfectly structured to achieve the results" for which they are designed (Darling-Hammond & Friedlaender, 2007, p. 13). Caldwell and Spink (2008) define transformation as "significant, systematic and sustained change that secures success for all students in all settings" (p. 3). At the core of transformation in the science, education of traditionally underserved students is a focus on educational equity (Borman, 2005). According to Darling-Hammond and Friedlaender (2007) transformation "not only helps students achieve academically, but also dramatically transforms their life prospects, is not attained merely by teachers 'trying harder' within traditional bureaucratic constraints" (p. 13). Science teachers in these schools engage in systemic processes that support the transmission of equitable science education for all students. What this looks like varies according to each high school in the present study. The science programs within these schools carry out their daily work toward educational equity differently and with difficult limitations. Despite the limitations, administrators and science teachers in these schools are steadfast in their beliefs about the students they serve and use of instructional and organizational strategies, which are part of the science program to transform achievement in science.

Measuring Equity in Science Education

Analysis of two urban middle school science programs by Kahle and Hewson (2003) identified certain conditions believed to contribute to equitable education in science, especially among culturally diverse student groups. As part of their work, they developed the equity metric, a metric useful in measuring equity in schools. The Wisconsin Center for Education Research (WCER, 2003) indicates, “The metric delineates the conditions within classrooms, schools, and districts that define equity in science education” (p. 2). In four categories, Kahle’s equity metric articulates various indicators of equity. Those categories are: (1) student access to quality education, (2) student retention within the system and within mathematics and science, (3) student achievement because of participation in the system, and (4) overall indicators (WCER, 2003, Kahle, 1998). Additionally, indicators of inequity were identified through a process that involved combination of a number of sources including public national databases (i.e., National Education Longitudinal Study of 1988, High School and Beyond, and Trends in International Mathematics and Science Study), National Science Foundation indicators, research literature and the assessment of systemic reform initiatives (Kahle, 1998). Indicators that were evident in school systems were assigned to appropriate categories in the equity metric. Kahle (1998) states the intention of developing the equity metric was “to identify indicators that:

- are sensitive to diversity among groups
- are used to inform action, not only to define the present state;
- are flexible, because not all metrics are relevant to all parts of the system;

- distinguish between opportunity, accessibility, and participation;
- are directed toward leverage points in the system; and
- are feasible to use (i.e., affordable) (p. 10)

Therefore, contrary to mainstream assumptions, a single characteristic, such as high performance outcomes on assessments (e.g., tests), does not justify the existence of equity in schools. Kahle indicates the equity metric moves "beyond a statistical analysis of student achievement as the primary measure of equity in a system" (Kahle, 1998, p. 10). Knowledge of this point serves to reshape perspectives on what to recognize, and even evaluate as evidence of equity in schools. For this reason, qualitative evidence is equally valuable when making considerations about the evidence of equity. A once regarded "elusive target" (p. 4) for school systems is distinguishable because of Kahle's (1998) equity metric. Kahle's equity metric illustrates how to assess progress towards equity, especially in science. This occurs by operationalizing or defining concepts and variables associated with equitable teaching and learning.

Darling-Hammond and Friedlaender (2007) arrive at a similar conclusion concerning qualitative evidence pointing to equity in schools. In their case study analysis of five academically successful high schools serving predominately low-income and diverse students, they indicate high expectations; access to rigorous coursework; teachers using culturally relevant pedagogy to connect with students; and authentic learning experience as qualities of equity (Darling-Hammond & Friedlaender, 2007). Additionally, the use of multiple authentic assessments and other qualities like "trusting and personal relationships between and among students and staff and [demonstrating] a commitment to social and racial justice" (p. iii) contribute to an equitable learning environment in science for all students (Darling-Hammond & Friedlaender, 2007).

Equity in Culturally Diverse High Schools

Darling-Hammond and Friedlaender (2007) conducted a statewide study of high achieving urban high schools in the state of California. Similar to the PRISE research, this study identified high achieving schools using multiple selection criteria including both high graduation and college entrances rates. Based on parameters of proportionally large culturally diverse student population, school setting, socioeconomic status, and achievement, a population of three hundred sixty high schools were considered for participation in their study. However, the researchers chose five schools to retain a small sample for qualitative analysis (Darling-Hammond & Friedlaender, 2007).

The purpose of the Darling-Hammond and Friedlaender study was to describe the practices, design features, and performance outcomes of five urban high schools successful at preparing predominately low-income students of color for college. Additionally, their study served to provide policy recommendations to improve, maintain, or change schools into equitable and just learning environments for all students (Darling-Hammond & Friedlaender, 2007). These researchers found that of the numerous practices implemented, they are align and rooted in a central belief that all students have the intellectual capital and ability to go to college.

In their case study analysis, Darling-Hammond and Friedlaender (2007) delve into specific features at high schools contributing to equity and student achievement throughout schools. Similar to the indicators listed in the systemic equity pedagogy SEP rubric, these particular features are categorized as personalization, rigorous and relevant instruction, and professional learning and collaboration (Darling-Hammond & Friedlaender, 2007). Additionally, these specific design features present a combination of both pedagogical and non-pedagogical practices in each category. Table 4.1 provides a list of these featured practices. According to Darling-Hammond and Friedlaender (2007), these well-documented design features create the foundation to propose new policy to influence other schools serving culturally diverse students in other school settings. Additionally, these features provide concrete descriptions of various approaches deemed credible and used for promoting equity in highly diverse school settings.

Table 4.1

High School Design Features for Equity

Personalization	Rigorous and Relevant Instruction	Professional Learning and Collaboration
1. Small learning environments	1. College preparatory curriculum	1. Allocate time for teachers to work collaboratively
2. Continuous, long-term relationship between students and adults	2. Career preparations through internship, coursework, and other real-world experiences	2. Professional development time built into the school year
3. Advisory system that organizes support in counseling, academics, and family connections	3. Authentic learning experiences through performance assessments	3. Weekly joint-planning time
4. Block schedules	4. Interventions involving culturally relevant instructional support and scaffolding	4. Faculty involvement in determining and enacting shared goals
5. Co-teaching model	5. Curriculum about students' communities and culture	5. Democratic decision making involving faculty, parents, and students
	6. Parental outreach efforts	
	7. Partnerships with local community groups, industries, and higher education	

Note. Source High Schools for Equity Policy Brief, p. viii.

Rationale

The rationale for this chapter is three fold. First, teachers' perceptions differentiate among their colleagues at different schools. Second, science teachers' perceptions differ in their practices of SEP indicators. Third, differences exist among science teachers' perceptions across schools of different demographics. This research will provide an understanding of science teachers' approach and attitude toward implementing systemic and equitable science education that result in achievement and college readiness in high school science programs.

Problem Statement

Prior research exist that documents school-level practices supporting equity, student achievement, and college-readiness (Darling-Hammond and Friedlaender, 2007 & Kahle, 1998). In science education however, the knowledge base for understanding program-level processes and practices that promote equity, student achievement and college readiness must be developed. This chapter examines science programs in successful high schools with particular focus on the practices and perceptions of science teachers.

Research Question

Three research questions help guide knowledge of teachers situated in science programs. They are: 1) How do teachers' perceptions vary in different science programs? 2) How do teachers' perceptions differ in what they do? 3) How do teachers' perceptions vary in science programs of differing demographics?

Methods

Research Design

This study involves the use of mixed-methods research methodologies. The PRISE-II Research Group, located in the College of Education and Human Development at Texas A&M University, collected data to inform the development of the SEP rubric. The participants in the study were science teacher liaisons and science teachers within ten high schools selected by purposeful sampling. The school principal at each of the ten schools identified the science liaisons at their respective campus and staff members identified as science teachers.

Participants

The PRISE-II Research Group identified 28 high schools as having large culturally diverse student populations that were also highly successful in science achievement and college readiness (Bozeman and Stuessy, 2011). To conduct their research, the Group selectively chose ten of 28 schools. Formal letters, telephone contacts, and campus visits describe efforts used to request the participation of each campus principal in the ten high schools. After meeting face-to-face with each high school principal, we obtained permission to conduct our research with the science liaisons and science teachers in each school. Ten science liaisons and 123 science teachers were participants in the study.

Data Collection

Qualitative and quantitative data were collected for use in this study. Qualitative data describing the school science program was collected using a structured interview of the science liaison and teachers. Quantitative data describing science teacher practices was collected using survey response data. All data was collected during the spring of 2012 and archived using standard practices.

Qualitative Data Collection

The PRISE Research team conducted a single 60-minute structured interview session with science teacher liaisons at the ten high schools. Each one-on-one interview was recorded using a digital audio recorder, and field notes were taken. The instrument used to collect data was a 29-item Science Program Interview (SPI) instrument (see Appendix A for the Science Program Interview). The SPI focused on four elements within a high school science program. These elements focused on the organization, curriculum, instructional priorities, and vision of the science program (Stuessy & Bozeman, 2011). The purpose was to gather information which described specific equitable teaching and learning practices (or indicators) within high achieving high school science programs. Additionally, the interviews provided perspectives of the instructional practices used to meet the needs of the culturally diverse student populations. The science teacher liaisons' interpretations are used to inform the list of indicators within the SEP rubric. In the previous chapter, Table 4.2 illustrates SEP drivers that correspond to the SPI instrument.

Quantitative Data Collection

The Texas Poll for Secondary Science Teachers (TPSST) was utilized to gather information from 126 high school science teachers within the study (Bozeman & Stuessy, 2011). The TPSST is a thirty-six item Likert scale tool which assesses science teachers' level of participation in professional activities and attitude about their work environment (Bozeman & Stuessy, 2011). Several questions related to teacher use of equitable teaching and learning practices in science are embedded into the TPSST. Table 4.2 details the list of embedded TPSST items associated with equitable teaching and learning strategies.

Table 4.2

Corresponding SEP Drivers to Science Program Interview Items

Driver	Systemic Equity Pedagogy	Science Program Interview Items
1	Standard-based Curriculum and Instructional Materials	10a, 11, 12, 13
2	Reform-based Policies in Science	14a, 14b, 14c, 14d, 25
3	Convergence of Resources into Science Programs	11, 13
4	Stakeholder Support	1, 2, 3, 5, 6
5	Professional Development	7a, 7b, 8
6	Professional Culture	10a, 16, 25, 26, 27a, 27b, 28, 29
7	Culturally Responsive Pedagogy	14a, 18a, 18b, 19a, 19b, 19c, 24
8	Student Achievement Indicators	20, 22

Note. Science program data collected the Science Program Instrument.

Data Analysis

I obtained data for this chapter from three archived data sources: electronic audio recordings, interview transcripts, and a teacher survey database. Two stages marked the process of analyzing the research data. In the first stage of analysis, I conducted a comprehensive content analysis of each SPI audio recording. This process involved repeated and careful listening of each SPI audio recording while also using the SEP rubric in order to check-off concrete and/or inferred educational practices indicated by each science liaison during the interview. This process of assessment occurred for all ten science programs. In the second stage, I made brief notes of salient nuances that distinguished the science programs' approach to effective teaching practices.

I conducted data analysis using both quantitative and qualitative approaches. For this study, I used two phases of analysis. In the first phase, a content analysis of the literature review and science program transcripts data generated indicators for each driver. Constant comparative techniques were applied to form a rubric, generalize meaning within each driver, and categorize indicators (Creswell, 2007).

Embedded TPSST items relating to equitable science teaching strategies were compiled and analyzed using Likert scale responses. This quantitative analysis resulted in the calculation of mean and standard deviation values for each high school science program. The Science Teacher Equity Score (STES) is derived from the mean value in this analysis. A linear form of representation was considered for the equity scores data in order to clarify the relationship of data points to one another and explain how science teachers varied in their perceptions. As an additional effort to highlight any variation, equity score differences were also figured. A four-point scale was used in order to quantify indicators within the rubric. A mean score was assigned to each science program and descriptive statistical analysis was conducted.

Results of Teachers' Perception in Science Programs

In the first research question, I sought to understand how teacher perceptions of their approach to SEP differed from their colleagues in other science programs. Table 4.3 and Figure 4.1 illustrate the STES for each science program. This score represents science teachers' perception of the frequency in which they perform SEP strategies during the course of their daily work. The average score for science programs, using aggregated teacher data was 33.1 with a standard deviation of 3.16. This score indicates frequent use of SEP strategies by teachers within these science programs.

Teachers gave responses to twenty-nine embedded questions on equitable teaching and learning strategies in science. Results calculated based on a four-point Likert scale assessing frequency where 1 = Never, 2=Seldom, 3=Sometimes, and 4=Often, yielded an average response represented each science program. Science teachers firmly responded on average that they "sometimes" use key research-based equitable teaching and learning strategies in science. The median value, which also represents the average score for the ten other science programs is 33.1 points.

Teachers' perception of their implementation of SEP strategies does vary among schools in the study. In Figure 4.1 the dashed line, signaling the median value separates two distinctive groups within the data. Teachers in high school science programs listed above the median value (i.e., SP 51, SP 53, SP 54, SP 56, and SP 60) demonstrate a greater propensity to use equitable pedagogy. In contrast, teachers in the science programs listed below the median value (i.e., SP 52, SP 55, SP 57, SP 58, and SP 62) may not consistently implement strategies related to SEP.

Table 4.3

Science Teacher Equity Score

Science Program	N	Mean	Std. Deviation
51	20	33.6	3.05
52	4	31.5	5.68
53	9	34.4	3.24
54	8	33.6	2.26
55	9	32.7	2.73
56	12	33.8	1.46
57	10	32.7	2.45
58	18	32.9	3.46
60	12	34.4	3.55
62	21	31.2	3.30
Total	123	33.1	3.16

Note. Descriptive statistical analysis using SPSS.

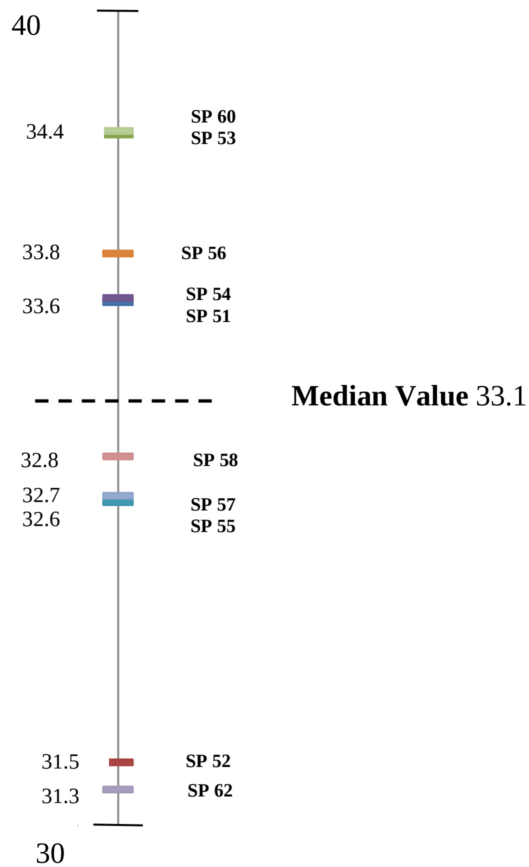

Figure 4.1. Science Teacher Equity Score (STES) by science program is based on aggerated teacher responses using the Texas Poll for Secondary Science Teachers evaluation of SEP strategies.

Among the ten science programs, the highest STES is 34.4 points (SP 60) and the lowest is 31.3 points (SP 62). Between these two terminal points in the data are differences and cluster patterns revealing similarities in practice among the other science programs. In a few cases, science programs had the same equity score. Both SP 51 and

SP 54 shared a score of 33.6 points and SP 53 and SP 60 scored 34.4 points. This occurrence may provide evidence that schools engage in the work of equity differently, yet they may also possess extremely common perspectives toward their general practice. Additionally, these four science programs are located above the median value, which may indicate a greater propensity to use equitable pedagogical approaches more often on a day-to-day basis. Table 4.4 provides an illustration of the equity score differences and cluster patterns among the ten science programs. Science programs with an equity score difference of “0” have the same average value on the TPSST instrument. Those with an equity score difference between 0.1 points and 0.5 points maintain average values with little difference. These specific science programs are located near one another on the STES scale, thus resulting in a clustering effect. This table also shows the largest differences in equity score average values between the science programs. Science programs with the largest difference of 3.1 average value points are SP 53, SP 60, and SP 62.

Table 4.4

Science Teachers' Equity Score Differences

Science Programs	51	52	53	54	55	56	57	58	60	62
51	-	2.1	0.8	0	1.0	0.2	0.9	0.8	0.8	2.3
52	2.1	-	2.9	2.1	1.1	2.3	1.2	1.3	2.9	0.2
53	0.8	2.9	-	0.8	1.8	0.6	1.7	1.6	0	3.1
54	0	2.1	0.8	-	1.0	0.2	0.9	0.8	0.8	2.3
55	1.0	1.1	1.8	1.0	-	1.2	0.1	0.2	1.8	1.3
56	0.2	2.3	0.6	0.2	1.2	-	1.1	1.0	0.6	2.5
57	0.9	1.2	1.7	0.9	0.1	1.1	-	0.1	1.7	1.4
58	0.8	1.3	1.6	0.8	0.2	1.0	0.1	-	1.6	1.5
60	0.8	2.9	0	0.8	1.8	0.6	1.7	1.6	-	3.1
62	2.3	0.2	3.1	2.3	1.3	2.5	1.4	1.5	3.1	-

Note. Differences were calculated by subtracting equity score average values of each science program.

Table 4.5

Frequency Scores of Equitable Teaching Strategies in Science Programs

STRATEGY	Very often (%)	Sometimes (%)	Seldom (%)	Not at all (%)	Total (%)	Mode
Questioning	71.5	-	28.5	-	100	4
Enhanced context	78.9	20.3	0.8	-	100	4
Collaborative learning	61.0	36.6	2.4	-	100	4
Manipulation	36.6	54.4	8.9	-	100	3
Multiple assessment	53.7	45.5	0.8	-	100	4
Scientific inquiry	47.2	45.5	6.5	0.8	100	4
Learning by project-based	24.4	43.9	27.6	3.3	99.2	3
Learning by performance-based	51.2	39.8	8.1	0.8	100	4
Communicate w/principal concerning science achievement	5.7	34.1	33.3	26.8	100	3
Communicate w/ non-principals concerning science achievement	56.9	25.2	10.6	7.3	100	4

Note. Science program scores based on aggregated teacher responses (n = 123) on the TSSTP assessment tool. * Indicates missing response. Mode value of 3 represents (sometimes) and 4 (often) on Likert scale.

Frequency scores in Table 4.5 reveals teacher perception of their use of equitable teaching strategies in science programs. Analysis of frequency scores show that a majority of these practices are implemented at a reoccurring rate described as “very often” to “sometimes”. Enhanced context, collaborative learning, manipulation, multiple assessment, scientific inquiry, and communication with non-principals concerning science achievement, are equitable teaching strategies used at a reoccurring rate of eighty percent or higher by teachers in these ten science programs. The least used equitable teaching strategy involves science teachers communicating with principals concerning the science achievement of culturally diverse students, in which 39.8% of respondents indicate they use. The most frequently used (i.e., very often and sometimes) equitable teaching strategies are both enhanced context and multiple assessments, in which respondents indicate they use at a rate of 99.2% of the time in science programs.

Analysis of modal values for each equitable teaching strategy shows the rate of general use. Based on a Likert scale where 4 = Often, 3=Sometimes, 2=Seldom, and 1=Never, strategies in Table 4.5 were classified at either a 3 or 4. The common and frequent use of these equitable teaching strategies is believed to influence student success in these science programs.

In this next stage, we seek to understand how science teachers’ perceptions vary in the way they apply equitable science teaching strategies. The results show a number of important occurrences involving the relationship between science programs to science teachers’ equity scores. Figure 4.2 illustrates this relationship.

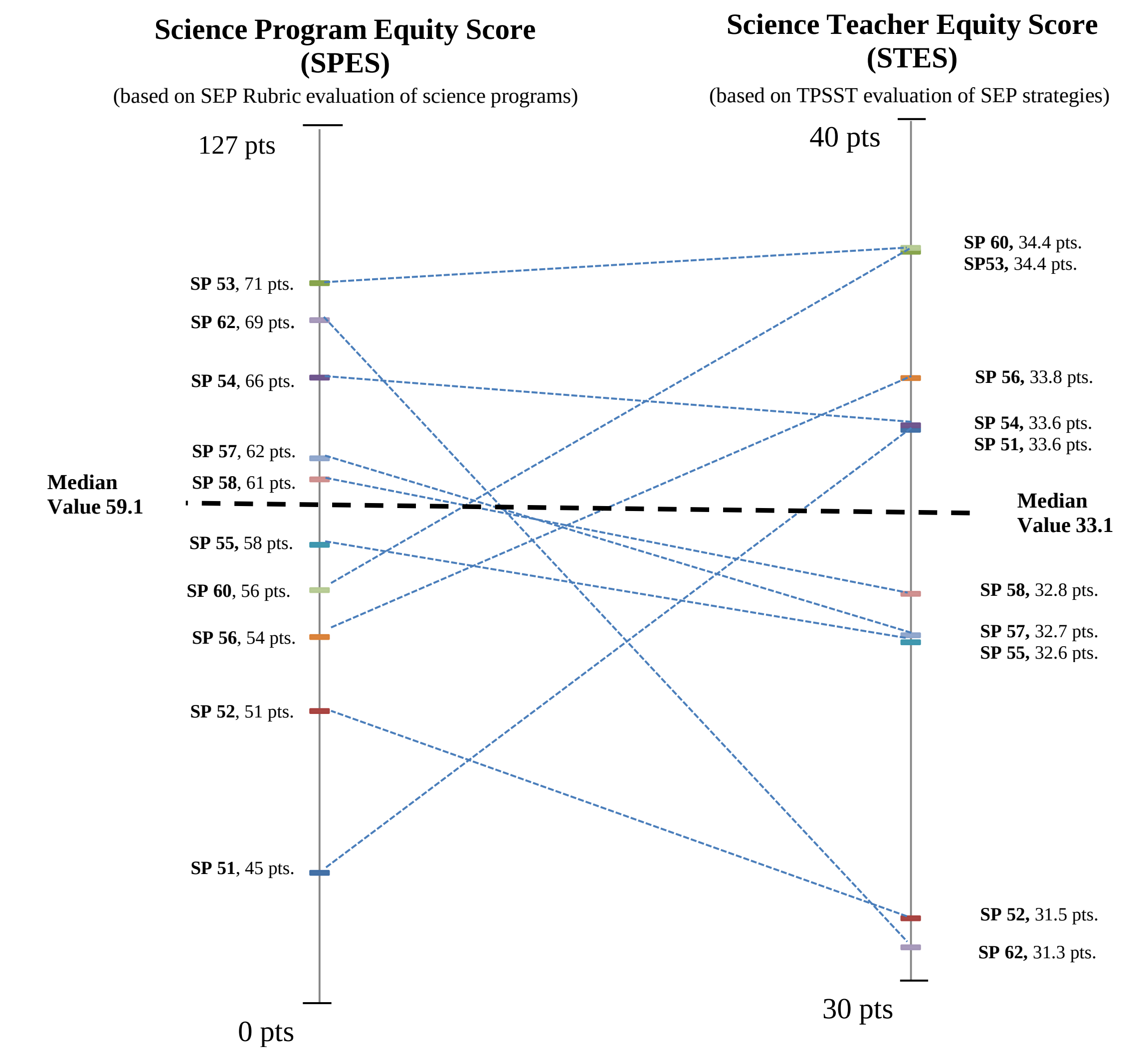

Figure 4.2. Science Teacher and Science Programs Perception. This figure illustrates the relationship of SPES to STES about the median value.

According to SPES and STES results in Figure 4.2, perceptions between science programs and science teachers for each high school vary about the median value. Because high schools in this study represent highly successful institutions serving large proportions of traditionally underserved students in science, an assumption existed by the researcher for there to be less variability between SPES and STES. Instead, science programs were located in three different areas (i.e. above, below, and through) the median value (see Table 4.6).

Table 4.6

Relationship of SP/ST Equity Scores to Median Value

High School Science Programs	SPES	STES	Relationship of SP/ST Equity Scores to Median Value	Levels of Implementation between SP/ST Perceptions
53	A	A	Above	High
54	A	A		
51	B	A	Through	Varied
56	B	A		
57	A	B		
58	A	B		
60	B	A		
62	A	B		
52	B	B	Below	Low
55	B	B		

Note. A = above the median value, B = below median value, ST = science teacher, SP = science program, SPES = science program equity score, and STES = science teacher equity score.

Interesting findings emerge when analyzing the relationship of SP/ST equity scores to demographic descriptor for each science program. Table 4.7 provides a list of the student population and demographic information by science program. These schools vary in many ways. Table 4.7 illustrates differences between each school's student population, as well as the racial and ethnic composition of their students. Other significant differences, however not mentioned in the table, were high schools' location throughout Texas, school setting type (i.e., rural, suburban, and urban), and funding amount received per student.

Table 4.7 provides a look at the relationship of SP/ST equity scores to demographic descriptors. As indicated earlier, perceptions between science programs and science teachers for each high school differs about the median value (see Figure 4.2). Science programs in these proportionally large, culturally diverse high schools also differ individually in their use of equitable teaching and learning practices. However, an intriguing pattern emerges when analyzing SP/ST equity scores against demographic descriptors. This pattern suggests the difference in SP/ST perceptions of their practice may be related to size of the student population.

Table 4.7

School and Student Descriptors for Ten Science Programs

High school science program	Student population	Student demographic (%)				
		AA	A/PI	H	NA	W
51	2,952	0.5	2.6	89.3	0	7.4
52	113	7.1	-	72.6	-	19.5
53	505	-	-	98.8	-	1.2
54	807	39.2	23.3	15.2	0.2	20.8
55	937	37.8	13.4	38.0	0.9	7.8
56	1,997	0.4	2.2	93.9	-	3.0
57	2,117	0.5	1.9	90.9	0.1	6.0
58	2,264	12.5	1.8	74.2	0.3	10.9
60	2,411	53.6	12.8	25.4	0.1	5.0
62	3,685	0.1	0.2	97.5	0.1	1.8

Note. African American (AA), Asian/Pacific Islander (A/PI), Hispanic (H), Native American (NA), and White (W). Student population and demographic information gathered from Texas Education Agency, Academic Excellence Indicator System 2010-11 Campus Profile. http://ritter.tea.state.tx.us/perfreport/aeis/2011/campus.srch.html

Table 4.8 illustrates the relationship of SP/ST perception of implementing equitable science teaching practices to demographic descriptors. In this study, science programs in high schools with extremely high student populations (i.e., between 1,997 – 3,685 students) were all rated as "varied" in their perceptions of using equitable teaching practices in science. Perceptions between science program and science teachers in these high schools fluctuated about the median value (see Table 4.6 and Figure 4.2). These science programs were SP 51, SP 56, SP 57, SP 58, SP 60, and SP 62. Science programs with student populations ranging approximately between 500 and 800, rated “high”. Therefore, the perceptions of implementing equitable teaching and learning practice between the science program and science teachers in these high schools were above the median value. Two science programs rated “low” in their perceptions for using equitable teaching and learning practices. The science program and science teachers’ perceptions in SP 52 and SP 55 were below the median value. These high schools have the student population sizes of both 113 and 937, respectively.

In regards to race and ethnicity, further study is required to determine potential connections existing between perceptions of using equitable teaching and learning practices and other science programs in the study. Science programs with perceptions registering below the median value (i.e., SP 52 and SP 55), did have similar proportional compositions of non-white-to-white students within their population. For SP 52 and SP 55, non-white student population was 79.7% and 76.7%, respectively. Meanwhile, white student population was 19.5% (SP 52) and 21.2% (SP 55).

Table 4.8

Relationship of SP/ST Perception of Implementation to Demographic Descriptors

High school science program	Levels of implementation between SP/ST perceptions	Student Population	Non-white (%)	White (%)
51	V	2,952	89.8	10
52	L	113	79.7	19.5
53	H	505	98.8	1.2
54	H	807	54.6	44.1
55	L	937	76.7	21.2
56	V	1,997	94.3	5.2
57	V	2,117	91.5	7.9
58	V	2,264	87.3	12.7
60	V	2,411	79.1	12.9
62	V	3,685	97.7	2.0

Note. High (H), Low (L), and Varied (V). Non-white = African American, Hispanic, and Native American. White= Caucasian and Asian/Pacific Islander. Science Program (SP) and Science Teachers (ST). Student population and demographic information gathered from Texas Education Agency, Academic Excellence Indicator System 2010-11 Campus Profile. http://ritter.tea.state.tx.us/perfreport/aeis/2011/campus.srch.html

Summary

Considering the level of implementation between science programs and science teachers is essential to understand the extent to which equitable practices are associated with performance outcomes, such as high science achievement and college readiness. For example, science program-science teacher equity scores located below the median value may indicate practitioners in these high schools are employing specific and necessary equitable practices to address their particular situation. Likewise, for science program-science teacher equity scores located above the median value, these practitioners are implementing as many equitable teaching practices in science to address specific needs for their educational setting. A science program-science teacher relationship that transitions through the median value line varies in their level of implementation. This may be due to frequently changing circumstances that are associated with the implementation of specific equitable practices at these schools. For example, receipt or elimination of program funds affects the schools' ability to maintain or expand services that support the promotion of equitable teaching practices. In fact, during the time of this study, the Texas Legislature cut the education budget by five billion dollars causing many school districts across the state to face severe budget shortfalls (Hernandez, 2012 & Smith, 2012).

This study shows science teachers in these ten schools hold divergent views on their use of equitable teaching and learning practices. While individual differences may vary among each science teacher, their collective attitude as a science program appears alike. Science programs that promote SEP have teachers that use these practices frequently.

CHAPTER V

CONCLUSION

There is much to learn concerning the association of systemic equity pedagogy (SEP) with science achievement and college readiness in science programs in highly successful, highly diverse high (HSHD) schools. Based on the Policy Research in Science Education (PRISE)-II study (Bozeman & Stuessy, 2010), science programs in these select high schools implement a variety of systemic and equitable educational practices, which support the academic achievement of all students, regardless of their cultural background (i.e., gender, race, ethnicity, language, and socioeconomic status). The SEP rubric lists these practices as indicators situated and aligned to categories and drivers.

Promoting equitable science programs no longer needs to be an elusive target for public high schools. Through use of mixed-method research, this study has provided explanations to three research questions by identifying indicators of a comprehensive SEP rubric, scoring science programs using the SEP rubric, and making known science teachers' perceptions concerning SEP.

In spite of other findings and results, the implementation of SEP is a complex process (Kahle, 1998). Furthering SEP underscores the need to recognize the roles of three core components (i.e., ideology, operations, and pedagogy) and their relationship to drivers in SEP. In this chapter, I will discuss these three components in the context for implementing SEP, incorporating cultural responsiveness (CR), and developing culturally responsive science classrooms and teachers in HSHD high schools. I finish this chapter by defining culturally responsive science programs.

Implementation of SEP

Implementing SEP is complex because no one action can lead to the type of program-wide success observed in science programs in this study. SEP describes a systems-approach to implementing equity pedagogy within a content area program. The definition of equity pedagogy developed by Banks (1995) was used in this dissertation. Banks (1995) defines equity pedagogy as "teaching strategies and classroom environments that help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function effectively within, and help create and perpetuate, a just, humane, and democratic society" (p. 152). Zirkel (2008) describes equity pedagogy as "pedagogical innovations" directed toward the purpose of establishing equitable learning experiences for all students by challenging conditions within the educational environment (p. 1157). Zirkel (2008) further states, "One focus of equity pedagogies is to develop and use teaching techniques and methods that can address different learning styles and to develop pedagogical approaches that facilitate the educational achievement of lower performing students" (p. 1157).

SEP considers other factors in the process of influencing equitable teaching and learning and moves beyond the scope of the classroom to influence both content area programs and school-level practices.

A Complex Process Incorporating Cultural Responsiveness

Developing science programs that meet the academic needs of all students involves a complex and multidimensional process embedded in cultural responsiveness (CR). The SEP rubric is symbolic of this process. Possessing eight interrelated drivers, thirty categories, and one hundred twenty-six indicators, the SEP rubric represents both the depth and complexity of the process involved in designing science programs that model systemic and equitable educational practices.

Several definitions for CR underscore a central notion that numerous and inclusive actions are involved, especially in organizations serving culturally diverse student populations. Together, these definitions help construct an understanding and context by which multiple pedagogical and non-pedagogical practices are performed. For example, Sullivan and A'Vant (2009) define CR as:

> [embracing] the varying sociocultural histories and experiences that students come from and [legitimizing] their funds of knowledge and lived experiences. That is students' cultural knowledge, experiences, and performance styles are used to facilitate their education experiences through the careful, critical reconsideration of how we conceptualize learning and performance. A culturally responsive approach to education is grounded in the belief that all students can excel in academic endeavors when (a) their culture, language, heritage, and experiences are valued and used to facilitate their learning and development; (b) when they are

provided access to high-quality programs, services, and supports

(Klingner et al., 2005). ("Moving Toward Culturally Responsive," para. 7).

From the point of view for a non-educational institution, CR encompasses "an inclusive approach of inquiry and action to foster effective programs, policies, and practices that are respectful of cultural conditions within communities" (para. 1, Colorado Division of Behavior Health). An academic program perspective of CR indicates, "cultural responsiveness refers to the ability to take a person's culture and help that person infuse it into another culture, making it uniquely one" (para. 1). Based on these definitions, CR involves the inclusion of others and their cultural distinctions in order to operate or function effectively as an institution.

The implication for the science programs in this study suggests that CR incorporates the cultural attributes of students. This guiding principle influences the way these programs function and contribute to successful achievement and college readiness outcomes. Each of the programs has a different way of operating within the overall SEP framework as shown by significant differences in the Science Program Equity Score (SPES). Despite SPES differences, the continuous promotion of cultural responsiveness for programs occurs through science teaching and science classrooms that are both culturally responsive.

Both science teaching (Atwater et al, 2010 & Brown, 2007) and science classrooms (Brown, 2007) make up essential components in the process of developing science programs that exhibit SEP. Culturally responsive science teaching is evident as these science programs accommodate students' cultural characteristics in their curricular, instructional and assessment practices (Atwater et al, 2010). To this point, the SEP rubric shows how these programs accommodate learning for their students. In both pedagogical and non-pedagogical educational practices, each of the programs uses a different combination response to teaching culturally diverse students. Likewise, culturally responsive science classrooms become manifest through teaching and fostering a classroom environment supportive of cultural diversity.

Developing Culturally Responsive Science Classrooms

Culturally responsive science classrooms result when teachers within these science programs engage a variety of student-centered and inclusive practices that fosters science learning for culturally and linguistically diverse students (Brown, 2007 & Nichols, Rupley & Webb-Johnson, 2000). According to Montgomery (2001), culturally responsive classrooms function to "specifically acknowledge the presence of culturally diverse students and the need for these students to find connections among themselves and with the subject matter and the tasks the teacher asks them to perform" (p. 4). Brown (2007) indicates that teachers in culturally responsive classrooms maintain two important aspects. First, they maintain a positive belief in students' ability to learn (Brown, 2007). Secondly, they use "instructional strategies and teaching behaviors … [that] engage the students and lead to improved academic achievement" (Brown, 2007, p. 60).

Defining Culturally Responsive Science Teaching

Gay (2001) defines culturally responsive teaching "as using cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively" (p. 106). Science programs in this study practice culturally responsive teaching. Through their use of authentic, inclusive, and personally meaningful instructional strategies and activities, the lived experiences and frame of references of culturally diverse students are part of the science programs approach to teaching science (Gay, 2002 & Nieto, 2001). For example, the seventh driver in the SEP rubric, Culturally Responsive Teaching, offers a list twenty-nine specific actions that summarize these activities and strategies in highly successful, highly culturally diverse science programs (See Appendix C).

Culturally responsive science programs result from the collaboration between campus administration and science teachers within science programs. Teachers and administrators in these programs play an important role in supporting the facilitation of SEP. As previously mentioned, the belief that culturally diverse students possess the intellectual capacity and capability to learn science successfully is essential to CR. A reoccurring theme from use of the Science Program Interview (SPI) was the notion that educators (i.e., campus principal, assistant principal, and science teachers) in highly successful, highly diverse schools believed in their students. Acting in line with their beliefs, these same individuals would work collaboratively within programs to perform numerous pedagogical and non-pedagogical practices indicated in the SEP rubric.

Core Components of Systemic Reform in Culturally Responsive Science Programs

A systemic reform initiative focused on academic improvement of science programs considers three core components (i.e., ideological approach, operational approach, and pedagogical approach; Rodriquez, 2001). According to Rodriguez

(2001), these three components support the formation of a shared vision or systemic conceptual clarity. Rodriguez defines systemic conceptual clarity as “the shared vision that enables all those involved in the reform enterprise to imagine what the complex puzzle of systemic reform may look like in their own contexts, as they work toward making all the puzzle pieces fit together” (p. 1119). Consequently, these three components represent critical elements of change in the process of school reform, as well as other school academic programs (e.g., science programs). While science programs in this study are not part of any reform initiative, their success with culturally diverse student populations is indicative of those undergoing reform.

By virtue that schools represent educational systems, influencing academic improvements requires addressing the core components within this system. The eight-driver SEP model addresses each of these critical components and therefore provides an appropriate structure for developing equitable science programs. Figure 5.1 illustrates the relationship between SEP drivers and the three core components.

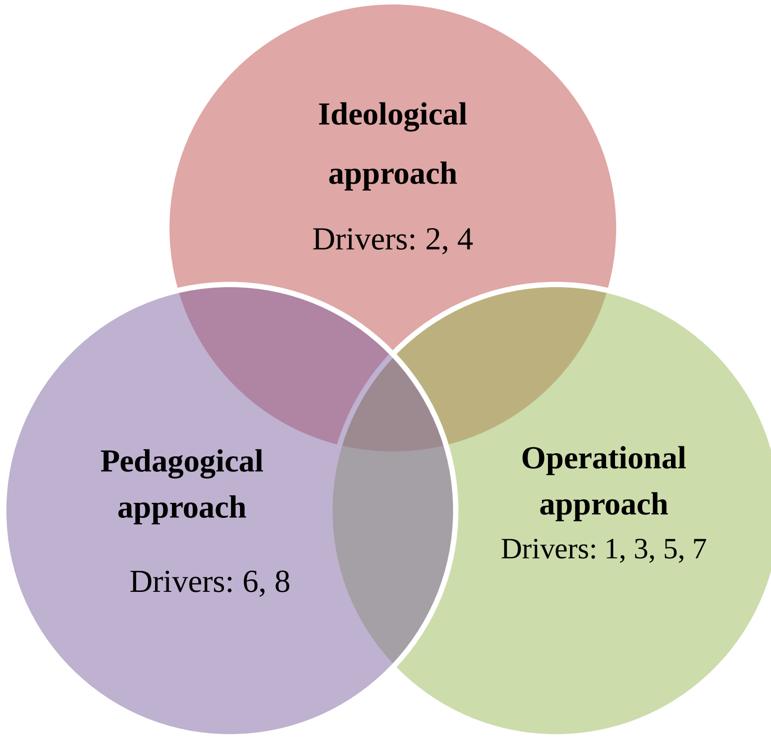

Figure 5.1. Relationship of SEP Drivers to Three Core Components

The SEP eight-driver model represents a collaborative and systemic process by which science programs in highly successful, highly diverse high schools promote equitable teaching and learning. These eight drivers separate into the three core components (i.e., ideology, operational, and pedagogy). Ideology is represented by the collective beliefs and values that guide actions and behaviors in the science program. Drivers 2 and 4 correlate the ideology component. The operational component represents the functional attributes these science programs are involved in order to carry out their work on a day-to-day basis. SEP drivers 1, 3, 5, and 7 associate with the component involving the operational aspects of science programs in the study. Pedagogy describes these science programs' approach to teaching and learning. Drivers 6 and 8 fit in the pedagogy category of the core component.

Structural Hierarchy for SEP Development

Science programs in this study are situated between two hierarchical levels. According to my observations of the programs in each high school, those levels are the campus-level, department-level, and classroom-level. The department-level represents the location of science programs. In this position, programs may function as a conduit to transfer SEP and CR into other classrooms in the science program.

Figure 5.2 represents a model for developing and promoting equitable high school science programs. I believe this model illustrates the essence of how science programs associate with culturally responsive teaching and classrooms and thus equitable outcomes.

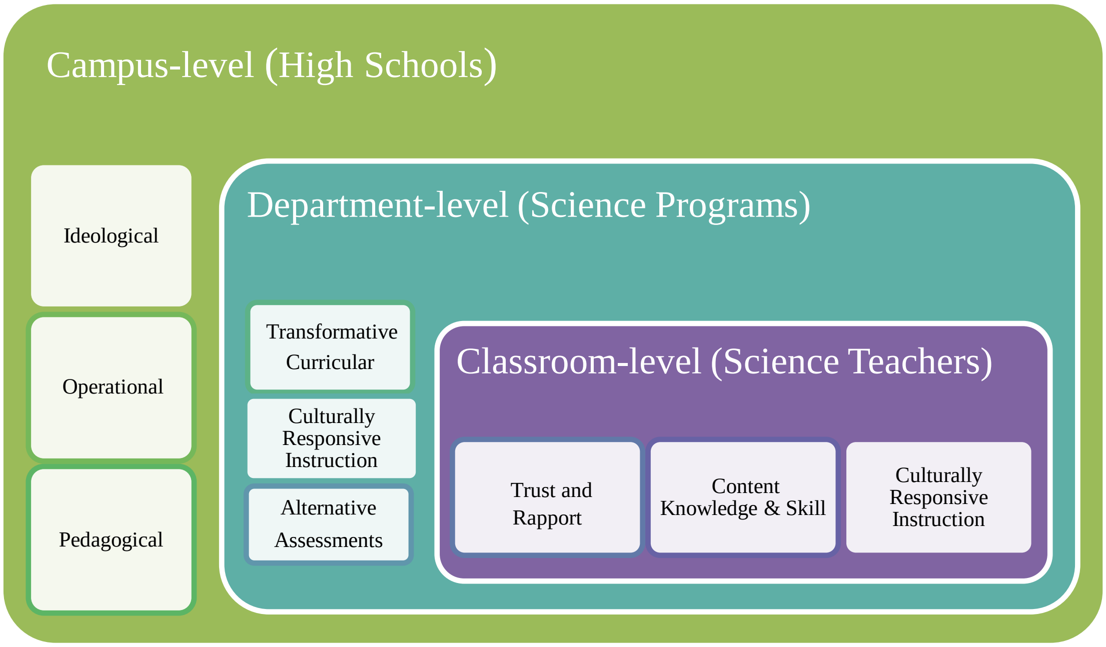

Figure 5.2. Equitable Science Program Model

Culturally responsive science programs require the systemic conceptualization of school-based equity pedagogy (Rodriguez, 2001). The first phase involves focus at the campus level. It is important to define the campus' beliefs and values or ideological approach toward student achievement in science. In interviewing the campus principal, science liaison or science department chairperson, and science teachers, I learned pertinent information about their beliefs and values regarding science teaching and student achievement. Using the same data collection technique, I obtained information about operational and pedagogical approaches that affect science instruction. In a school-based systemic conceptual framework, ideological, operational, and pedagogical approaches extend through the other structural levels of a school system, such as the science department and science classrooms.

The second phase of implementing culturally responsive science programs involves focus at the departmental level. In a high school setting, science programs may consist of an administrator and several science teachers. Together these faculty members work on curricular, instructional, and assessment related concerns. My research suggests improving science learning in these programs requires a transformative curriculum, culturally responsive instruction, and alternative assessment practices.

The third phase of implementing culturally responsive science programs involves focus at the classroom level. The role of the science teacher is most important in this model because of their direct interactions with students and ability to have the greatest effect on learning (Atwater & Brown, 1999; Darling-Hammond and Friedlaender, 2007; Tobin, 2001; 2005; 2006; & 2008). Because of my research, I believe influencing the learning of culturally diverse student populations in science programs requires building trust and rapport by promoting positive student/teacher relationships, using culturally responsive instructional practices that emphasize inquiry-based learning, and refining subject or content knowledge through ongoing professional development training.

Summary

The purpose of this study was to identify and describe the associations between systemic equity pedagogy (SEP) practices in highly diverse high schools and their students' science achievement and college readiness. This study focused on science programs in ten highly diverse Texas high schools serving students who exhibited high science achievement and college readiness.

From this dissertation, I have concluded that the implementation of SEP is a complex endeavor. Intertwined within ideological, operational, and pedagogical approaches are culturally responsive values that enable highly successful science programs to meet the academic needs of culturally diverse student populations in science.

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APPENDIX A

SCIENCE PROGRAM INTERVIEW

Organization

Players describes the individuals within a school's SP. Policies and practices determine who the individuals are within an SP.

1. **Describe the people in your school's SP and what do they do?**

2. **Describe the leaders in your school's SP?**

3. **What is the general structure of the SP?**
   A. Science department with a department head
   B. Teachers grouped according to subject disciplines, e.g. chemistry
   C. Science placed within an interdisciplinary team structure
   D. Other

4. **Describe a typical SP meeting?**
   A. Generally, what is the purpose(s) of these meetings?
   B. Who leads SP meetings?
   C. Does the SP typically meet as a whole group or in small subgroups?
   D. How often do SP meetings occur?
   E. Are these meetings regularly scheduled or do they occur more intermittently?
   F. Where do the meetings occur?

Communication describes the information pathways within a school's SP. Policies and practices determine how pathways work within an SP.

5. **How do SP members provide input about SP management issues (e.g., staffing and training, facility use, and budget)?**
   A. Do SP members provide input about staffing and training?
   B. Do SP members provide input about the facility needs of science teachers?
   C. Do SP members provide input about the SP budget?

6. Would you describe the decision-making process in the SP as top-down, bottom-up, or a balanced process?

Collaboration describes the support structures within a school's SP. Policies and practices determine how structures provide support within an SP.

7. Describe how the SP supports science teachers' professional development?
   A. How does your SP support professional development within the school?
   B. How does your SP support professional development outside the school?

8. How does the SP document Continuing Professional Education (CPE) hours?

Curriculum

Locus of deliberation describes methods used to generate conclusions within a school's SP. Policies and practices determine how curriculum conclusions are made within an SP.

9. Describe how your SP makes decisions about what is taught in your science curriculum?
   A. Describe the level of autonomy that science teachers have in shaping the school's science curriculum?
   B. How is the SP involved in the textbook selection and adoption process?
   C. How does the SP at your school address vertical alignment?

10. How does the SP implement the school's science curriculum?
   A. How does the SP provide teachers with a method for reflecting on their "teaching experiences"?

Resources describes materials used by teachers to support student learning with a school's SP. Policies and practices determine how curriculum materials are provided to and implemented within an SP.

11. How does the SP select and acquire resources?
   A. How does that process work?
   B. Where are these resources kept?
   C. What kinds of resources are they?

12. How does the SP encourage science teachers to use national reform documents?

13. How does the SP support the sharing of resources (e.g., pedagogical, curricular, mentoring, and assessment) among its members?

Instructional Priorities

Process describes techniques used by members to teach science within a school's SP. Policies and practices determine how instructional techniques are chosen and used within an SP.

14. How does your SP encourage teachers to use reform-based instructional methods?

A. How does the SP support the professional development of science teachers in inquiry-based instruction?
B. How does the SP encourage science teachers to include the history and the nature of science in their lessons?
C. How does the SP support inclusion of informal science activities?
D. How does the SP support out-of-school science participation (e.g., UIL)?

15. How does the SP support the integration of laboratory experiences into science curricula?

16. How do SP members support a teacher's individuality in the classroom?

A. How do SP members support individual teaching styles?
B. How do SP members support individual personal practices?

Engagement describes the connections that students make within a school's SP. Policies and practices determine how student connections are created within an SP.

17. Describe how your SP encourages students to think about science in relation to developing career plans?

A. How does the SP encourage teachers to develop career-related experiences for students within the school's walls?
B. How does the SP encourage teachers to develop career-related experiences for students outside the school's walls?

18. Describe how your SP encourages students to think about science in relation to personal interests?

A. How does the SP encourage teachers to provide students with personally relevant learning experiences within the school's walls?
B. How does the SP encourage science teachers to provide students with personally relevant learning experiences outside the school's walls?

19. How does your SP encourage students to think about science in relation to social issues?

A. What social issues are emphasized by the SP?
B. How does your SP integrate these issues within the school's science curriculum?
C. How does your SP encourage teachers to raise these issues with students?

20. How does the SP assist students in matching their academic interests to the different science courses offered at the school?

Assessment describes the evaluation methods used by members of a school's SP. Policies and practices determine how evaluation methods are generated and used within an SP.

21. How does your SP assess students' overall achievement in science?

A. Does your SP encourage the use of benchmark-type tests?
B. How does your SP support science teachers to prepare students for state-mandated tests?
C. How does your SP use assessments to inform future decisions?

22. How does your SP enable teachers to customize instructional practices to suit the unique learning needs (e.g., ESL, LD, giftedness, socio-economic status, and gender) of students in their classroom?

Vision

23. What is the greatest strength of your school's SP?

24. What is the greatest weakness of your school's SP?

25. What professional practices are most commonly shared by teachers in the SP?

26. What professional philosophies are most commonly shared by teachers in the SP?

27. Finally, is there anything special or unique that you would like to share with us about your school's SP?

APPENDIX B

TEXAS POLL OF SECONDARY SCIENCE TEACHERS

1. (a) Have you formally participated in recruiting new science teachers since the fall of 2010? *(Please enter a check on just one line below.)*

____ Yes *(If yes, go to question #1b.)*

____ No *(If no, go to questions #2.)*

(b) Please indicate all of the ways that you have formally participated in the recruitment of new science teachers. *(Please check all that apply).*

____a. Formal interviews at the school site

____b. Informal visits with perspective science teachers

____c. Recruitment trips outside school walls

____d. Policy meetings specific to science

____e. Review job applications for prospective science teachers

____f. Other *(Please briefly explain).*

2. (a) Have you participated in the induction/mentoring of new science teachers since the fall of 2010? *(Please enter a check on just one line below.)*

____ Yes *(If yes, go to question #2b)*

____ No *(If no, go to question #3)*

(b) Please indicate all of the ways that you have participated in the induction/mentoring of new science teachers. *(Please check all that apply.)*

____a. Assisted with orientation to school policies

____b. Assisted with classroom management

____c. Observed a new science teacher teaching

____d. Modeled teaching for a new science teacher

____e. Provided a new science teacher with a science lesson

____f. Developed a science lesson with a new science teacher

____g. Performed formal mentoring duties with a new science teacher

____h. Other *(Please briefly explain.)*

3. (a) Since the fall of 2010, have you served in a leadership role? *(Please enter a check on just one line below.)*

____ Yes *(If yes, go to question #3b)*

____ No *(If no, go to question #4)*

(b) Please indicate the leadership roles you have held since the fall of 2010. *(Please check all that apply).*

____ a. Science department chair

____ b. Science curriculum writer

____ c. Science club/organization sponsor

____ d. Mentor to a science teacher

____ e. Member of a science teacher professional organization

____ f. Presenter at a science workshop, conference, or training session

____ g. Mentor to a teacher who is not a science teacher

____ h. Subject team leader in a subject other than science

____ i. Member of a teacher professional organization that is not specifically science-related

____ j. Member of a district-level decision-making committee

____ k. Other leadership role. (Please specify below.)

4. Since the fall of 2010, in which of the following professional development activities have you participated? *(Please enter a check in all lines below that apply to you.)*

____ a. Strategies for teaching science content

____ b. Strategies for teaching science using technology

____ c. Strategies for teaching science using the Texas Essential Knowledge and Skills (TEKS)

____ d. Strategies for preparing students to master the Texas Assessment of Knowledge and Skills (TAKS) objectives

____ e. Strategies for teaching science to students with special needs

____ f. Strategies for the use of laboratory in teaching science

____ g. Strategies for teaching science by inquiry

____ h. None of the above

____ i. Other. (*Please specify below*.)

5. Since the fall of 2010, in which of the following activities have you engaged that were specific to science or science education? *(Please enter a check in all lines below that apply to you.)*

____ a. Teacher research on innovative practice in science
____ b. Peer observations of other science teachers
____ c. Graduate studies in a science field
____ d. Educator study groups
____ e. Professional science teaching associations
____ f. Curriculum writing
____ g. Mentoring of science student teachers
____ h. Other *(Please specify below.)*

6. When teaching a class, how often do you use questioning strategies?

Questioning strategies refer to the varying of timing, positioning, or cognitive level of questions given to students.

____ a. Very often
____ b. Sometimes
____ c. Seldom
____ d. Not often at all

7. When teaching a class, how often do you use enhanced context strategies?

Enhanced context strategies refer to linking student prior experience with new knowledge.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

8. When teaching a class, how often do you use collaborative learning strategies?

Collaborative learning strategies refer to the arrangement of students in groups to work on tasks.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

9. In a typical weeks' instruction, how often do you use manipulation strategies?

Manipulation strategies refer to student use of physical objects in their learning.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

10. During a semester, how often do you use multiple assessment strategies?

Multiple assessment strategies refer to the frequency, purpose, or cognitive levels of testing/evaluation.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

11. During a semester, how often do you use inquiry strategies?

Inquiry strategies refer to the use of learner-centered instruction.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

12. During a semester, how often do you assess learning with project strategies?

Project strategies refer to the use of projects to assess student learning.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

13. During a semester, how often do you assess learning with performance strategies?

Performance strategies refer to the use of performance to assess student learning.

____ a. Very often

____ b. Sometimes

____ c. Seldom

____ d. Not often at all

14. What are the three biggest challenges you face in implementing science instruction?

A. ____

B. ____

C. ____

15. In a typical semester, how often do you informally meet (that is, not during a scheduled science department meeting) with science teachers at your school about issues related to science teaching? *(Please enter a check on just one line below.)*

____ a. Daily

____ b. Once a week

____ c. Twice a week

____ d. Once a month

____ e. Twice a month

____ f. Once a semester

____ g. Twice a semester

____ h. Almost never

16. Overall, how satisfied are you with your decision to become a high school science teacher? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

17. How much do you agree with this statement: Improving student achievement in science is a team effort at this school? *(Please enter a check on just one line below.)*

____ a. Strongly agree

____ b. Agree

____ c. Disagree

____ d. Strongly disagree

18. How satisfied are you with the level of cooperation and collegiality among all the teachers at this school? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

19. How satisfied are you with the way your science program contributes to the career development of students at this school? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

20. How satisfied are you with the decisions you can make about the instructional methods you use in your own science classroom? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

21. How satisfied are you with the support you receive from the school to have your students attend informal science activities, such as field trips, visits to museums, and off-campus activities at informal science institutions? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

22. How satisfied are you with the options that you have at your school for participating in science-specific professional development? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

23. How satisfied are you with the support provided by your school for you to participate in professional development? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

24. How satisfied are you with your science laboratory facilities? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

25. How satisfied are you with your science laboratory equipment? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

26. How satisfied are you regarding the recognition you receive for your science teaching efforts at this school? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

27. How satisfied are you with your current teaching assignment? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

28. How would you rate your personal level of safety at this school? *(Please enter a check on just one line below.)*

____ a. Excellent personal safety

____ b. Good personal safety

____ c. Fair personal safety

____ d. Poor personal safety

29. How satisfied are you with the administrative communication you receive about expectations for your teaching in this school? *(Please enter a check on just one line below.)*

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

30. Do you have an undergraduate degree in a biological or physical science field?

_____ No

_____ Yes

31. Do you have a graduate degree in a biological or physical science field?

_____ No

_____ Yes

32. Including this year (2011-2012) as one year, how long have you taught science at this school? *(Please enter the number of years in the box below.)*

# of years

33. Please provide your full name.

First	*Middle*	*Last*	*Maiden (if applicable)*

APPENDIX C

SEP RUBRIC

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	
		Engage in self-questioning following instruction (i.e., "How did it go with your class?"; "Did it work?"; "Why did it not work?" and "What may I need to change?")	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom's Taxonomy	
		Incorporate hands-on laboratory activities	
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	
	Instructional Material Distribution	Designate a convenient and central locations on campus	
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	
		Includes sharing pedagogical methods (e.g., instructional strategies)	
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	
		Support from science department chairperson	
		Support from science content specific lead teacher	
		Support from science teachers	
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	
		Communicate regarding professional development opportunities	
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	
		Attend science education conferences (e.g., CAST)	
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	
		Reflect best practices	
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	
		Support collegiality	
		Develop strong classroom management	
		Promote caring for student needs	
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	
		Encourage PD attendance and participation	
		Analyze data of student performance results	
		Prepare for benchmark exams	
		Communicate frequently	
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	
		Facilitate hands-on instruction	
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	
		Integrate social issues topics into classroom discussions	
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	
		Encourage student participation in advance placement courses	
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre- or post-unit tests	
		Use periodic benchmark district assessments	
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

APPENDIX D

SEP RUBRIC BY SCIENCE PROGRAMS

School Science Program No. 51

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	•
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	•
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	●
		Promote inquiry through workshops and various professional development opportunities	
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	
		Incorporate hands-on laboratory activities	●
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	●
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	●
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	●
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	●
	Instructional Material Distribution	Designate a convenient and central locations on campus	
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	●
		Includes sharing pedagogical methods (e.g., instructional strategies)	
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	●
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	●
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	●
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	●
		Attend science education conferences (e.g., CAST)	●
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	●
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	
	Teacher Individuality	Encourage greatly within the science program	●
		Align with curriculum standards	●
		Reflect best practices	
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	
		Support collegiality	●
		Develop strong classroom management	●
		Promote caring for student needs	
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	●
		Analyze data of student performance results	●
		Prepare for benchmark exams	
		Communicate frequently	●
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	●
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	
		Operate as a team	●

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	
		Facilitate hands-on instruction	
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	•
	Promote Personally Relevant Instruction	Seek to understand student interests	•
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	
		Integrate social issues topics into classroom discussions	
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	•
		Encourage student participation in advance placement courses	
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre- or post-unit tests	
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

Science Program No. 52

Systemic Equity Pedagogy Rubric

Driver	Category	Indicator	
Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	●
		Conduct classroom observations with follow-up curriculum-focused discussions	●
		Conduct collaborative curriculum and instructional planning meetings	●
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	●
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	●
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	●
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	●
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	●
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	●
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	●
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	●

Driver	Category	Indicator	
Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	●
		Incorporate hands-on laboratory activities	●
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Note. Drivers, categories and science program level indicators of SEP.

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	•
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	•
		Lead teacher requisitions for materials and resources	
	Instructional Material Distribution	Designate a convenient and central locations on campus	•
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	•
		Includes sharing pedagogical methods (e.g., instructional strategies)	•
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	•
		Includes mentoring and classroom visits	•
		Includes sharing student assessment results	•
Stakeholder Support	School Level	Collaborate between science department and campus administrators	•
		Support from science department chairperson	
		Support from science content specific lead teacher	
		Support from science teachers	•
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	•
		Communicate regarding professional development opportunities	
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	•
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	•
		Attend science education conferences (e.g., CAST)	
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	•
	Teacher Individuality	Encourage greatly within the science program	•
		Align with curriculum standards	
		Reflect best practices	
	Science Program Strength	Nurture connection with students	•
		Increase cohesion & mutual respect among professionals	
		Support collegiality	•
		Develop strong classroom management	
		Promote caring for student needs	•
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	•
		Encourage PD attendance and participation	
		Analyze data of student performance results	•
		Prepare for benchmark exams	
		Communicate frequently	•
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	
	Professional Philosophy	Maintain high expectation for student achievement	•
		Promote collaboration in the classroom and among classroom teachers	
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	•
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	•
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	
		Facilitate hands-on instruction	●
		Facilitate student led in-class demonstrations	●
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	●
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	●
	Engage Student Personal Interests	Tailor instruction to student personal interest	●
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	●
		Integrate social issues topics into classroom discussions	●
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advance placement courses	
		Encourage student participation in advance placement courses	
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	●
		Modify science lessons	●
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	●
		Use periodic benchmark district assessments	●
		Use in-state released standardize assessments	●
		Use out-of-state released standardize assessments	●

School Science Program No. 53

Systemic Equity Pedagogy Rubric

Driver	Category	Indicator	
Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	•
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	•
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	•
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Driver	Category	Indicator	
Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	•
		Promote inquiry through workshops and various professional development opportunities	
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	•
		Use of questioning strategies aligned with Bloom’s Taxonomy	•
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	•
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	•
		Utilize a cross disciplinary approach to teaching science	•
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	•
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	•
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	•

Note. Drivers, categories and science program level indicators of SEP.

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	●
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	●
	Instructional Material Distribution	Designate a convenient and central locations on campus	●
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	
		Includes sharing pedagogical methods (e.g., instructional strategies)	●
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	●
		Includes mentoring and classroom visits	●
		Includes sharing student assessment results	●
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	●
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	●
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	●
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	●
	Outside School/District	Attend PD offered through regional education service centers	●
		Attend science education conferences (e.g., CAST)	
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	●
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	
	Teacher Individuality	Encourage greatly within the science program	●
		Align with curriculum standards	●
		Reflect best practices	
	Science Program Strength	Nurture connection with students	●
		Increase cohesion & mutual respect among professionals	
		Support collegiality	●
		Develop strong classroom management	
		Promote caring for student needs	●
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	
		Analyze data of student performance results	●
		Prepare for benchmark exams	
		Communicate frequently	
		Care for each other	●
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	
		Prioritize students learning and success at the first order of business	●
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	●
		Maintain a professional attitude	●
		Employ student-centered approaches in teaching science	
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	●
		Facilitate hands-on instruction	●
		Facilitate student led in-class demonstrations	●
		Facilitate project-based learning	●
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	●
		Integrate technology during science learning	●
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	●
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	●
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	●
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	
		Integrate social issues topics into classroom discussions	
		Integrate social issue topics into the curriculum	●
	College Ready Preparation	Provide advanced placement courses	●
		Encourage student participation in advance placement courses	●
		Encourage teacher to pursue graduate degrees in order to develop early college program	●
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	●
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	●
		Provide before/after school tutoring opportunities for students	●
Student Achievement Indicators	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	●
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

School Science Program No. 54

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	•
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	•
		Review and revise instructional strategies based on formative and summative assessments	•
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	•
		Consider needs of the science program	
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	•
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	•
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	•
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	•
		Utilize a cross disciplinary approach to teaching science	•
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	•
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	●
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	
	Instructional Material Distribution	Designate a convenient and central locations on campus	●
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	
		Includes sharing pedagogical methods (e.g., instructional strategies)	
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	●
		Includes mentoring and classroom visits	●
		Includes sharing student assessment results	●
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	●
	District Level	Support from science content specialist	●
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	●
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	●
Professional Development (PD)	Within School/Distric t	Access to pre-determined PD aligning with district science curriculum	●
		Offer PD during professional learning community meetings	●
		Sponsor on-campus PD opportunities in science	●
	Outside School/District	Attend PD offered through regional education service centers	
		Attend science education conferences (e.g., CAST)	●
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	
Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	●
		Develop systematized instructional improvement processes	●
		Practice self-reflective questioning of teaching progress and practices	●
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	●
		Reflect best practices	●
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	
		Support collegiality	
		Develop strong classroom management	
		Promote caring for student needs	●
		Promote horizontal & vertical curriculum alignment	●
		Maintain high teacher retention	●
	Shared Practices Among Teachers	Share materials and resources willingly	
		Encourage PD attendance and participation	●
		Analyze data of student performance results	●
		Prepare for benchmark exams	●
		Communicate frequently	●
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	●
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	●
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	●
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	•
		Facilitate hands-on instruction	•
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	•
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	•
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	•
		Integrate social issues topics into classroom discussions	•
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	
		Encourage student participation in advance placement courses	•
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	•
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	•
		Modify science lessons	•
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

School Science Program No. 55

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	•
		Engage in self-questioning following instruction (i.e., "How did it go with your class?"; "Did it work?"; "Why did it not work?" and "What may I need to change?")	•
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	•
		Promote inquiry through workshops and various professional development opportunities	•
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom's Taxonomy	
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	
	History and Nature of Science Emphasis	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	•
		Participate in university sponsored school science programs	•
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	•
	Instructional Material Distribution	Designate a convenient and central locations on campus	
		Encourage teachers to share materials among colleagues	•
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	•
		Includes sharing pedagogical methods (e.g., instructional strategies)	•
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	•
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	
		Support from science department chairperson	•
		Support from science content specific lead teacher	
		Support from science teachers	
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	•
		Communicate regarding professional development opportunities	•
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	•
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	•
		Attend science education conferences (e.g., CAST)	•
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	•
	Teacher Individuality	Encourage greatly within the science program	•
		Align with curriculum standards	
		Reflect best practices	
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	•
		Support collegiality	•
		Develop strong classroom management	
		Promote caring for student needs	•
		Promote horizontal & vertical curriculum alignment	•
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	•
		Encourage PD attendance and participation	
		Analyze data of student performance results	
		Prepare for benchmark exams	
		Communicate frequently	•
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	•
	Professional Philosophy	Maintain high expectation for student achievement	•
		Promote collaboration in the classroom and among classroom teachers	
		Prioritize students learning and success at the first order of business	•
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	•
		Operate as a team	•

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	•
		Facilitate hands-on instruction	•
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	•
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	•
		Link science content to related careers in science	•
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	•
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	•
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	•
		Integrate social issues topics into classroom discussions	•
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	•
		Encourage student participation in advance placement courses	•
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	•
		Employ differentiated instruction	
		Modify science lessons	•
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	•
		Use out-of-state released standardize assessments	

School Science Program No. 56

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	•
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	•
		Promote inquiry through workshops and various professional development opportunities	
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	•
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

	Instructional Material Provision	Furnish by school district	•
		Allocate budget to science department through campus administration	•
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	
	Instructional Material Distribution	Designate a convenient and central locations on campus	•
		Encourage teachers to share materials among colleagues	•
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	•
		Includes sharing pedagogical methods (e.g., instructional strategies)	
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	
		Support from science department chairperson	•
		Support from science content specific lead teacher	•
		Support from science teachers	
	District Level	Support from science content specialist	•
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	•
		Communicate regarding professional development opportunities	
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	•
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	•
		Offer PD during professional learning community meetings	•
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	•
		Attend science education conferences (e.g., CAST)	•
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

	Reflective Teaching Practices	Engage in collaborative instructional planning	•
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	•
		Practice self-reflective questioning of teaching progress and practices	•
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	
		Reflect best practices	•
	Science Program Strength	Nurture connection with students	•
		Increase cohesion & mutual respect among professionals	•
		Support collegiality	•
		Develop strong classroom management	
		Promote caring for student needs	•
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	•
		Encourage PD attendance and participation	
		Analyze data of student performance results	•
		Prepare for benchmark exams	•
		Communicate frequently	
		Care for each other	•
		Seek to know students	•
		Meet frequently and willingly	•
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	•
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	•
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	•
		Facilitate hands-on instruction	
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	•
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	•
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	
		Integrate social issues topics into classroom discussions	•
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	•
		Encourage student participation in advance placement courses	•
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	•
		Employ instruction in English as a Second Language (ESL)	•
		Employ differentiated instruction	•
		Modify science lessons	•
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

School Science Program No. 57

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	•
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	•
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	•
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	•
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	•
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	•
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	●
	Instructional Material Distribution	Designate a convenient and central locations on campus	
		Encourage teachers to share materials among colleagues	●
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	●
		Includes sharing pedagogical methods (e.g., instructional strategies)	●
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	●
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	●
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	●
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	●
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	●
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	●
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	
		Attend science education conferences (e.g., CAST)	●
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	●
		Practice self-reflective questioning of teaching progress and practices	●
	Teacher Individuality	Encourage greatly within the science program	●
		Align with curriculum standards	
		Reflect best practices	●
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	
		Support collegiality	●
		Develop strong classroom management	
		Promote caring for student needs	
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	●
		Analyze data of student performance results	●
		Prepare for benchmark exams	
		Communicate frequently	●
		Care for each other	●
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	●
		Promote collaboration in the classroom and among classroom teachers	●
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	●
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	●
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	•
		Facilitate hands-on instruction	•
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	•
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content/programs to related careers in science	•
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	•
	Engage Student Personal Interests	Tailor instruction to student personal interest	•
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	•
		Integrate social issues topics into classroom discussions	•
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	•
		Encourage student participation in advance placement courses	
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	•
		Modify science lessons	•
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre- or post- unit tests	
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	•
		Use out-of-state released standardize assessments	

School Science Program No. 58

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	•
		Conduct classroom observations with follow-up curriculum-focused discussions	
		Conduct collaborative curriculum and instructional planning meetings	•
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	•
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	•
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Basis of Selecting Instructional Materials	Align with school district science curriculum	
		Consider needs of the science program	•
		Solicit science teacher feedback on instructional resources	
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	•
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	•
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	•
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	•

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	•
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	
		Incorporate hands-on laboratory activities	•
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	•
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	•
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	•
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	●
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	●
	Instructional Material Distribution	Designate a convenient and central locations on campus	●
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	●
		Includes sharing pedagogical methods (e.g., instructional strategies)	
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	
		Includes sharing student assessment results	●
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	
		Support from science teachers	●
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	●
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	
		Sponsor on-campus PD opportunities in science	●
	Outside School/District	Attend PD offered through regional education service centers	
		Attend science education conferences (e.g., CAST)	
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	●

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	●
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	●
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	●
		Reflect best practices	●
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	●
		Support collegiality	
		Develop strong classroom management	
		Promote caring for student needs	●
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	●
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	
		Analyze data of student performance results	●
		Prepare for benchmark exams	
		Communicate frequently	●
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	
		Prioritize students learning and success at the first order of business	●
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	●
		Employ student-centered approaches in teaching science	
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	•
		Facilitate hands-on instruction	•
		Facilitate student led in-class demonstrations	•
		Facilitate project-based learning	
		Facilitate cooperative learning	•
		Facilitate science learning within a laboratory	•
		Integrate technology during science learning	•
	Career Plan Development	Post information on various science careers throughout classroom	•
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	•
		Increase positive student-teacher rapport	•
	Engage Student Personal Interests	Tailor instruction to student personal interest	
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	•
		Integrate social issues topics into classroom discussions	•
		Integrate social issue topics into the curriculum	•
	College Ready Preparation	Provide advanced placement courses	•
		Encourage student participation in advance placement courses	•
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	•
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	•
Student Achievement Indicators	Assessment Usage	Use pre/post test	•
		Use periodic benchmark district assessments	•
		Use in-state released standardize assessments	•
		Use out-of-state released standardize assessments	

School Science Program No. 60

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	●
		Conduct classroom observations with follow-up curriculum-focused discussions	●
		Conduct collaborative curriculum and instructional planning meetings	●
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	●
		Engage in self-questioning following instruction (i.e., “How did it go with your class?”; “Did it work?”; “Why did it not work?” and “What may I need to change?”)	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	●
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	
	Basis of Selecting Instructional Materials	Align with school district science curriculum	●
		Consider needs of the science program	●
		Solicit science teacher feedback on instructional resources	●
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	●
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	●
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom’s Taxonomy	
		Incorporate hands-on laboratory activities	
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	●
		Participate in university sponsored school science programs	
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	
		Allocate budget to science department through campus administration	●
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	●
		Lead teacher requisitions for materials and resources	
	Instructional Material Distribution	Designate a convenient and central locations on campus	●
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	
		Includes sharing pedagogical methods (e.g., instructional strategies)	●
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	●
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	●
	District Level	Support from science content specialist	●
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	●
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	●
		Offer PD during professional learning community meetings	●
		Sponsor on-campus PD opportunities in science	●
	Outside School/District	Attend PD offered through regional education service centers	●
		Attend science education conferences (e.g., CAST)	●
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	
		Practice self-reflective questioning of teaching progress and practices	
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	●
		Reflect best practices	
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	
		Support collegiality	●
		Develop strong classroom management	
		Promote caring for student needs	
		Promote horizontal & vertical curriculum alignment	
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	●
		Analyze data of student performance results	●
		Prepare for benchmark exams	●
		Communicate frequently	●
		Care for each other	
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	●
		Prioritize students learning and success at the first order of business	●
		Engage staff in analyzing data for achievement	
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	
		Maintain a professional attitude	
		Employ student-centered approaches in teaching science	●
		Operate as a team	

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	
		Facilitate hands-on instruction	●
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	●
		Integrate technology during science learning	
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	●
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	
		Recognize cultural differences among students	●
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	●
	Engage Student Personal Interests	Tailor instruction to student personal interest	●
		Arrange classroom visits by professional in science-related fields	
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	●
		Integrate social issues topics into classroom discussions	●
		Integrate social issue topics into the curriculum	●
	College Ready Preparation	Provide advanced placement courses	●
		Encourage student participation in advance placement courses	●
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	●
		Employ instruction in English as a Second Language (ESL)	●
		Employ differentiated instruction	●
		Modify science lessons	●
		Employ Response to Intervention (RTI) strategies	
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	●
		Use periodic benchmark district assessments	●
		Use in-state released standardize assessments	
		Use out-of-state released standardize assessments	

School Science Program No. 62

Systemic Equity Pedagogy Rubric

Standard-based Curriculum & Instructional Materials	Reflective Curriculum Practices	Analyze post-test data	●
		Conduct classroom observations with follow-up curriculum-focused discussions	●
		Conduct collaborative curriculum and instructional planning meetings	●
		Develop and use higher level questioning strategies	
		Review and revise instructional strategies based on formative and summative assessments	
		Engage in self-questioning following instruction (i.e., "How did it go with your class?"; "Did it work?"; "Why did it not work?" and "What may I need to change?")	
		Evaluate student work products	
		Post learning objective aligned with curriculum goals	
	National Reform Document Usage	Promote familiarity of reform documents through dissemination to classroom teachers through campus administrators	●
		Promote familiarity of reform documents through dissemination at district level curriculum meetings with science department chairpersons	
		Incorporate into the Texas Essential Knowledge and Skills (TEKS) curriculum standards	●
	Basis of Selecting Instructional Materials	Align with school district science curriculum	●
		Consider needs of the science program	●
		Solicit science teacher feedback on instructional resources	●
		Select on the basis of the Texas Essential Knowledge and Skills (TEKS) curriculum standards	●
	Instructional Material & Resources	Use technological tools (e.g., standardize test prep software programs, calculator, laptop, interactive white board, document camera, projector, and technology cart)	●
		Use non-technological (e.g., textbooks, consumables, paper, pencil, manipulative, charts, and paper clips)	●
		Use scientific hands-on resources (e.g., microscopes, dissection kits, chemicals, triple beam, electronic balance, and other common laboratory equipment)	●

Reform-based Policies in Science Education	Inquiry-based Teaching	Encourage inquiry teaching as an alternative to direct teaching methods	
		Promote inquiry through workshops and various professional development opportunities	●
		Provide in-classroom support to implement inquiry and other reform-based instructional strategies	
		Facilitate student-led investigation and problem solving	
		Use of questioning strategies aligned with Bloom's Taxonomy	●
		Incorporate hands-on laboratory activities	●
		Model real-life inquiry science learning	
	History and Nature of Science	Conduct field studies (e.g., parks and outside areas around campus)	
		Communicate using lecture/discussion strategies	
		Utilize a cross disciplinary approach to teaching science	
	Informal and Extracurricular Science Participation	Participate in career days (e.g., presentation of jobs in science related fields)	●
		Participate in science oriented science organizations and clubs (e.g., robotics, recycle, rockets, and environmental clubs)	●
		Participate in science competitions and fairs (e.g., Science Olympiad, UIL Science)	●
		Participate in university sponsored school science programs	●
		Participate in field trips to science related venues (e.g., nuclear power plants, arboretum, planetarium, or zoo)	●

Convergence of Resources within Science Program	Instructional Material Provision	Furnish by school district	●
		Allocate budget to science department through campus administration	
		Designate within end of year campus improvement planning	
		Obtain loaned equipment from regional education service centers	
		Lead teacher requisitions for materials and resources	●
	Instructional Material Distribution	Designate a convenient and central locations on campus	●
		Encourage teachers to share materials among colleagues	
	Type of Resources Shared	Includes sharing scientific apparatuses and multi-media tools	●
		Includes sharing pedagogical methods (e.g., instructional strategies)	●
		Includes sharing curricular tools (e.g., books, quizzes, and tests)	
		Includes mentoring and classroom visits	●
		Includes sharing student assessment results	
Stakeholder Support	School Level	Collaborate between science department and campus administrators	●
		Support from science department chairperson	●
		Support from science content specific lead teacher	●
		Support from science teachers	
	District Level	Support from science content specialist	
		Support from district level administrator in curriculum and instruction	
	Communication Pathways	Provide input to campus administrators on issues effecting supplies, lab equipment and in class materials	
		Communicate departmental needs via email or verbal communication	●
		Communicate regarding professional development opportunities	●
	Decision-making Process	Establish a balanced process for making decisions (e.g. campus administration and teachers share decisions about managing the science program)	●
		Establish a top-down process for making decisions (e.g., campus administration decides how science program is managed and passed those plans down to teachers)	
Professional Development (PD)	Within School/District	Access to pre-determined PD aligning with district science curriculum	
		Offer PD during professional learning community meetings	●
		Sponsor on-campus PD opportunities in science	
	Outside School/District	Attend PD offered through regional education service centers	●
		Attend science education conferences (e.g., CAST)	●
		Participate in informal social activities (i.e., after work hours gatherings at a restaurant)	●

Professional Culture	Reflective Teaching Practices	Engage in collaborative instructional planning	●
		Review generated data reports of students' academic background profile	
		Develop systematized instructional improvement processes	●
		Practice self-reflective questioning of teaching progress and practices	
	Teacher Individuality	Encourage greatly within the science program	
		Align with curriculum standards	●
		Reflect best practices	●
	Science Program Strength	Nurture connection with students	
		Increase cohesion & mutual respect among professionals	●
		Support collegiality	●
		Develop strong classroom management	
		Promote caring for student needs	
		Promote horizontal & vertical curriculum alignment	●
		Maintain high teacher retention	
	Shared Practices Among Teachers	Share materials and resources willingly	●
		Encourage PD attendance and participation	●
		Analyze data of student performance results	●
		Prepare for benchmark exams	
		Communicate frequently	●
		Care for each other	●
		Seek to know students	
		Meet frequently and willingly	●
	Professional Philosophy	Maintain high expectation for student achievement	
		Promote collaboration in the classroom and among classroom teachers	●
		Prioritize students learning and success at the first order of business	
		Engage staff in analyzing data for achievement	●
		Give frequent praise and expressions of gratitude to teachers	
	Special Science Program Attribute	Be passionate about teaching science	●
		Maintain a professional attitude	●
		Employ student-centered approaches in teaching science	
		Operate as a team	●

Culturally Responsive Pedagogy	Reform-based Instructional Practices	Facilitate inquiry-based teaching	●
		Facilitate hands-on instruction	●
		Facilitate student led in-class demonstrations	
		Facilitate project-based learning	
		Facilitate cooperative learning	
		Facilitate science learning within a laboratory	●
		Integrate technology during science learning	●
	Career Plan Development	Post information on various science careers throughout classroom	
		Develop career plans for students	
		Link science content to related careers in science	
	Promote Personally Relevant Instruction	Seek to understand student interests	●
		Recognize cultural differences among students	
		Promote student involvement in extracurricular science clubs and organizations	
		Increase positive student-teacher rapport	
	Engage Student Personal Interests	Tailor instruction to student personal interest	●
		Arrange classroom visits by professional in science-related fields	●
	Social Issues	Use of real-life issues related to science (e.g., environment, reproductive rights, etc.)	●
		Integrate social issues topics into classroom discussions	●
		Integrate social issue topics into the curriculum	
	College Ready Preparation	Provide advanced placement courses	●
		Encourage student participation in advance placement courses	●
		Encourage teacher to pursue graduate degrees in order to develop early college program	
	Customize Instructional Practices	Employ vocabulary enrichment activities	
		Employ instruction in English as a Second Language (ESL)	
		Employ differentiated instruction	
		Modify science lessons	
		Employ Response to Intervention (RTI) strategies	●
		Establish classroom reading stations	
		Provide before/after school tutoring opportunities for students	
Student Achievement Indicators	Assessment Usage	Use pre/post test	
		Use periodic benchmark district assessments	
		Use in-state released standardize assessments	●
		Use out-of-state released standardize assessments	●