SCIENCE TEACHING TIME AND PRACTICE, AND FACTORS INFLUENCING ELEMENTARY TEACHERS' DECISIONS ABOUT BOTH IN RURAL, RESERVATION SCHOOLS

by

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of the requirements for the degree

of

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DEDICATION

This work is dedicated to my father Raphael and my granddaughter Hope who both passed away while I was working on this dissertation. Life happens and we must go on. Dad, you and mom are responsible for what it is that makes me, me. Including the desire and stubbornness I needed to finish this project. Hopie, you always had a smile.

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TABLE OF CONTENTS

1. INTRODUCTION 1

Introduction 1
The Context 3
The Schools 3
The Reservations 5
Native American Students 7
Big Sky Science Partnership 9
The Purpose of This Study 14
Research Questions 15
Significance of Study 15
Limitations of the Study 17
Definition of Terms 18

2. LITERATURE REVIEW 20

Allocation of Teaching Time 20
International Comparisons 21
TIMSS 22
TIMSS Purpose 23
TIMSS Background Questionnaire Construction 24
TIMSS Teacher Questionnaires Sample 26
TIMSS Teaching Time Results 28
TIMSS Summary 29
A Global Study of Intended Instructional Time 30
Methodology for a Global Study of Intended Instructional Time 31
Sample for a Global Study of Intended Instructional Time 32
Global Study of Intended Instructional Time Results 34
Global Study of Intended Instructional Time Summary 37
Teaching Time in the United States 38
National Assessment of Educational Progress (NAEP) 38
NAEP Methodology 39
NAEP Results 40
The Schools and Staffing Survey (SASS) 42
SASS Methodology 42
SASS Results 44
Surveys of Enacted Curriculum (SEC) 45
SEC Methodology 45
National Survey of Science and Mathematics Education 47
National Survey of Science and Mathematics Education Methodology 48
National Survey of Science and Mathematics Education Results 49

TABLE OF CONTENTS – CONTINUED

Summary of Teaching Time in the United States 49
Time and Learning in a National Context 51
Impacts on Teaching Time..... 54
Visions of Good Science Teaching and How Teachers are using Their Time 58
Project 2061..... 58
National Science Education Standards (NSES) 61
Standards and Recommendations for American Indian Students..... 64
Instructional Practices that have the Greatest Positive Effect for Native American Students 65
Learning Style 65
Understanding Student Culture 66
Culturally Meaningful Pedagogical Practices..... 68
How Teachers are Using Their Teaching Time 72
Research on Influences on Teachers' Instructional Decisions..... 75
Intrinsic Influences on Instructional Choices 76
Teacher Beliefs..... 77
Extrinsic Influences on Instruction Choice..... 79
Environmental Factors..... 80
Professional Development 84
Professional Development for Teachers of Native American Students 86
Cultural Understanding..... 88
Content Understanding 92
Collaborative Learning 95
Conclusions..... 98

3. METHODOLOGY 100

Introduction.....100
The Context 102
The Teachers.....103
The Big Sky Science Partnership (BSSP).....105
Selecting the Sample 105
Research Design.....108
Methods of Data Collections and Analysis.....109
Surveys of Enacted Curriculum (SEC).....110
Cultural Inclusion Survey (CIS) 111
Weekly Teaching Survey (WTS) 112
Classroom Observations 114
Interviews.....117
The Scoop Notebook 118
WebCT Posts 120

TABLE OF CONTENTS – CONTINUED

Creating Trustworthiness 120

4. ANALYSIS OF DATA 124

Introduction....124
Teaching Time 125
Surveys of Enacted Curriculum 126
Weekly Teaching Survey....130
Scoop Notebook 132
Interviews....134
Summary of Science Teaching Time Data 136
How The Teachers Are Using Their Science Teaching Time 137
Surveys of Enacted Curriculum 138
Summary of SEC Data....167
Weekly Teaching Survey (WTS) 168
Classroom Observation Protocol (COP)....188
Scoop Notebook 194
Interviews....197
Summary Of How The Teachers Are Using Their Science Teaching Time 199
What Influences Teachers' Decisions about How They Teach Science 200
Surveys of Enacted Curriculum 201
Weekly Teaching Survey (WTS) 205
WTS Reflection Question 216
Interviews....220
Summary of What Influences Teachers' Decisions about How They Teach Science 225

5. CONCLUSIONS 227

Introduction....227
Summary of Findings 229
Teaching Time....229
How Are The Teachers Using Their Teaching Time 232
What Influences Teachers' Decisions about How They Teach Science 234
Implications for Educators....236
Implications for Policy Makers....237
Recommendations for Further Research....240
Moving Beyond Annual Sampling of Time Devoted to Science Teaching....240
Measuring Teacher Practice....241
Understanding Influences on Teacher Instructional Choice....241
Summary....242

TABLE OF CONTENTS – CONTINUED

REFERENCES 244

APPENDICES.....266

APPENDIX A: Surveys of Enacted Curriculum (SEC) 267
APPENDIX B: Cultural Inclusion Survey (CIS) 284
APPENDIX C: Weekly Teaching Survey (WTS).....289
APPENDIX D: Classroom Observation Protocol (COP) 294
APPENDIX E: Interview Prompts 306
APPENDIX F: 2007 and 2008 SEC Graphical Results.....308
APPENDIX G: WTS Graphical Results and Reflection Comments.....317
APPENDIX H: Interview Transcript.....342

LIST OF TABLES

Table Page

1. Montana Student Results (Proficient) on 2001 – 2007 Science portion Iowa Test of Basic Skills grade 4 and 8 8

2. Yearly Instructional Time in Primary and Lower Secondary Education, Worldwide, circa 1985 and 2000, Constant Cases by Grade Level..... 35

3. Relative Emphasis on Major Subject Areas in Official Curricula, Worldwide, by Grade level, 1980s and 2000's, and percentage of total instruction time allocated to major subject areas (adapted from Benavot and Amadio 2004)..... 36

4. Average science teaching time in hours, by grade level and time period..... 37

5. NCES 1997 and NAEP 2005 science teaching time data for 4th grade 41

6. NAEP 2005 science teaching time data for 8th grade 41

7. SASS data by year, public or BIA school, number of teachers and response rate.(adapted from six years of data reports available from NCES)..... 43

8. Montana SEC teaching time reported by grade..... 47

9. Comparison of science teaching time in United States by instrument and year..... 50

10. Matrix of recommended culturally responsive instructional elements 71

11. Matrix of sample teachers by grade, school type, and professional development prior to participation in BSSP.....106

12. Matrix of non-sample teachers by grade, school type, and professional development prior to participation in BSSP.....107

13. Matrix of research data collection and analysis.....108

14. Matrix showing individual response changes for question 9 between the 2007 and 2008 administration of the SEC.....128

15. Matrix showing individual response changes for question 10 between the 2007 and 2008 administration of the SEC.....130

LIST OF TABLES – CONTINUED

Table Page

16. Matrix showing individual average weekly science teaching time in hours based on responses to question 1 on the WTS 131

17. Frequency distribution of teaching minute reports by day for all data, (*n* =80) 132

18. Matrix of teacher reported science teaching time by lesson as found in Scoop Notebook Calendar.....134

19. SEC questions 25 to 36 with questions that are further expanded in following subsections of the SEC in *italic* font.....140

20. Average response to SEC questions 25 -36, disaggregated by teacher and year.....141

21. Distribution of teachers regarding the amount of time devoted to various instructional practices (questions 25 – 36) 142

22. Individual teacher responses regarding the amount of time devoted to various instructional practices (questions 25 – 36). 143

23. SEC questions 36 to 45 expand the responses category established by question 29 in the previous section of the SEC.....147

24. Average response to SEC questions 37 -45, laboratory and non-laboratory related activities disaggregated by teacher and year. 148

25. Distribution of SEC responses for regarding laboratory and non-laboratory related activities (questions 37 – 45) 149

26. Individual teacher SEC responses regarding laboratory and non-laboratory related activities (questions 37 – 45). 150

27. Average response to SEC questions 46-51 regarding amount of instructional time in pairs or small groups other than during science in laboratory settings..... 155

28. Distribution of SEC responses regarding small non-laboratory group and pair activities (questions 46-51) 156

LIST OF TABLES – CONTINUED

Table Page

29. Individual teacher SEC responses regarding small non-laboratory group and pair activities (questions 46-51). 157

30. SEC question 31 and averages for questions 52 – 56, which focus on amount of instructional time devoted to the collection of science data or information other than in science laboratory settings 160

31. Distribution of SEC responses regarding data collection associated with non laboratory activities (questions 52-56) 161

32. Individual teacher SEC responses regarding data collection associated with non laboratory activities (questions 52-56). 162

33. SEC question 34 and averages for questions 57 – 62, which focus on amount of instructional time devoted to the use of technology for the learning of science ..164

34. Distribution of SEC responses regarding use of educational technology, (questions 57 – 62)....165

35. Individual teacher SEC responses regarding use of educational technology, (questions 57 – 62)....165

36. WTS and SEC question alignment....169

37. Group and individual average response to WTS questions 1 – 5 170

38. WTS Distribution questions 1-5 (*n* =80) 171

39. WTS and SEC Laboratory activity, investigation, or experiment question alignment....172

40. WTS responses to questions 6, 6a – 6h (*n* =80)....173

41. WTS and SEC instructional time in pair and small groups (other than lab)....178

42. Whole group response distribution to WTS questions 7, 7a – 7f (*n* =80) 179

LIST OF TABLES – CONTINUED

Table Page

43. Whole group response distribution to WTS questions 8 through 12 (*n* =80) 181

44. Matrix of teacher responses to WTS question 13 (*n* =80).....183

45. WTS sub questions for positive response to Question 13 compared with similar questions from Cultural Inclusion Survey (CIS) instrument 184

46. WTS Response distribution for questions 13a – 13d based on positive responses to question 13 (*n* = 33).....184

47. WTS questions 14 through 18 185

48. WTS Response distribution for questions 14 -18 (*n* =80).....185

49. Woolbaugh's Five Factors from the COP aligned with recommended Practices for Native American Learners.....188

50. SEC Instructional Influences questions investigated in this study 201

51. Average response to SEC questions 71 – 76 and 79, disaggregated by teacher.....202

52. WTS and SEC Instructional Influences question alignment 207

53. Average response to WTS questions 19b through 24b, disaggregated by teacher and giving overall mean and standard deviation for the sample (*n* =10).....208

54. Group and individual average response to WTS questions 19b – 24b (N=80) 208

55. Average response to WTS questions 19a through 24a, disaggregated by teacher and giving overall mean and standard deviation for the sample (*n* =80).....211

56. Group and individual average response to WTS questions 19a – 24a (*n* =80).....212

LIST OF FIGURES

Figure Page

1. Map of research area with approximate location of schools targeted by BSSP 4

2. Map of Montana showing all reservations with area of research specifically indicated 5

3. Intrinsic Influences (adapted from Ford, 1992 and Bandura 1997)..... 79

4. Extrinsic Influences (adapted from Ford 1992)..... 80

5. Teaching Instructional Decisions Result from the Interaction of Intrinsic and Extrinsic Factors 98

6. Two examples of graphic data used to frame themes for WTS. Shown are graphs of initial SEC's for question representing hours teaching science during a typical week and influence of State Tests 112

7. Frequency distribution 2007 and 2008 responses for SEC question 8 127

8. Frequency distribution 2007 and 2008 responses for SEC question 9 128

9. Frequency distribution 2007 and 2008 responses for SEC question 10 129

10. Frequency distributions graphs for SEC questions 31 and 32 in both 2007 and 2008 administrations 146

11. Frequency distributions graphs for SEC questions 39 and 42 in both 2007 and 2008 administrations of the instrument 153

12. Frequency distribution graph for SEC question 29 for both 2007 and 2008 administrations of the instrument.....154

13. Comparison of results between SEC question 44 and WTS question 6f 174

14. Comparison of results between SEC question 29 and WTS question 6 176

15. Comparison of results between SEC question 32 and WTS question 7 178

16. Comparison of results between SEC question 46 and WTS question 7c.....180

LIST OF FIGURES - CONTINUED

Figure Page

17. Comparison of results between SEC question 28 and WTS question 8 182

18. WTS Question 13.....183

19. Comparison of Factor Mean Score for BSSP research sample, Woolbaugh's (2004) sample, and national sample 190

20. Frequency distributions for SEC questions 71 through 76 and 79 from both 2007 and 2008.....203

21. Frequency distributions of responses to WTS questions 19b - 24b (*n* =80) 210

22. Frequency distributions of WTS questions 19a through 24a (*n* =80).....214

23. Distribution of Responses to WTS Reflection Question 25 (*n* =80).....216

ABSTRACT

An achievement gap exists between White and Native American students in Montana. Extensive research has shown that improving the quality of instruction for minority students is an effective way to narrow this gap. Science education reform movements emphasize that for science to be effective it must first be taught and that when taught, should use a variety of approaches, including inquiry. In Montana it is also essential that programs designed to improve science instruction include strategies recommended by the research that are effective for Native American students including contextualization within the culture, the use of modeling and demonstration, and collaborative engagement in learning. The ten teachers who participated in this study were engaged in such a program, the Big Sky Science Partnership (BSSP). This study investigates three questions. First, how much time are the teachers in the study teaching science? Second, what does this teaching look like in relation to the recommendations for best science practice found in the research? Third, what influences do the teachers feel drive their instructional decisions? The answers to these questions were based on both quantitative and qualitative measures including data from interviews, participant reflections, observations, and surveys. This study provides an in-depth description of the allocation of science teaching time for elementary teachers who work primarily with Native American students as well as providing valuable data regarding teaching practice. The study shows that both time and practice are influenced by many factors. The primary influence cited by the participants in this study was district focus on reading and mathematics instruction. Participants also indicated that their participation in the BSSP had a direct influence on the amount of time they devoted to science instruction as well as the content covered and the strategies used. Teachers' views about these influences provide insight into limitations that schools' physical structure, policy mandates, and culture can place on a teacher's ability to effectively teach science. In light of the results of the study, implications for educators and policy makers are addressed, and recommendations for future research are suggested.

CHAPTER ONE

INTRODUCTION

Introduction

Even before the current legislative drive to emphasize tested academic content and skills, The National Education Commission on Time and Learning (1994) cautioned that moving the curriculum to a focus on higher standards for the traditional subjects of English, mathematics, and science will translate into more school time being devoted to the teaching of these subjects at the expense of non-assessed subjects such art, geography and foreign languages which will be allocated less time. This situation is what Hargrove, Jones, Jones, Chapman, and Davis, M. (2000), in their pre No Child Left Behind (NCLB) study about the effects of high-stakes testing on the curriculum predicted. They commented that one of the greatest concerns with high-stakes testing is the enormous amount of time that will being spent on reading, writing, and mathematics at the cost of instruction in science, social studies, physical education, and the arts.

The current focus of NCLB legislation mandates that teachers have positive impacts on student achievement, specifically the areas of mathematics and English language arts (reading). Over the past six years this focus on reading and mathematics achievement has exacerbated the problem of inadequate teaching time for science. Up through 2007 science was not one of the targeted areas for measurement using standardized test scores to determine whether schools are making progress in reducing

achievement gaps among various subgroups of students. This narrow focus resulted in a serious imbalance in time on various content areas (Cawelti, 2006). McMurrer (2007), in her report on year five of the NCLB Act, found that 44% of all districts in her sample of 349 reported that they had increased teaching time for English language arts and/or mathematics while reducing teaching time for science and other subjects. The elementary schools in this study reported an average weekly increase of 141 minutes for English language arts and an average increase of 89 minutes per week for mathematics, while reducing science by an average of 75 minutes per week and social studies by 76 minutes. This data supports (Hargrove, Jones, Jones, Chapman, and Davis (2000) pre-NCLB study about the effects of high-stakes testing on the curriculum. They comment that one of the greatest concerns is the enormous amount of time that is being spent on reading, writing, and mathematics at the cost of instruction in science, social studies, physical education, and the arts. They observed that elementary schools focused on meeting expectations of high-stakes testing typically spent 75% of their time teaching reading and math, leaving inadequate instructional time for other subjects, leaving potential gaps in student learning.

In 2007 science became one of the areas targeted by high-stakes testing. In order to prepare for a renewed focus on science in the curriculum, it is essential to prepare teachers to engage all learners in both the content and the processes of science. In order to meet this looming need, Montana State University Center for Learning and Teaching in the West (CLTW), in conjunction with lead institution Salish Kootenai and the University of Montana, has developed the Big Sky Science Partnership (BSSP), a

professional development project designed to encourage teaching of science on a regular basis in participating districts, as well as the integration of science content with practices that support Native American students' learning. A goal of BSSP is to influence change in individual teaching practice, which Fullan and Hargreaves (1992) suggests is the most critical component of any change effort.

The Context

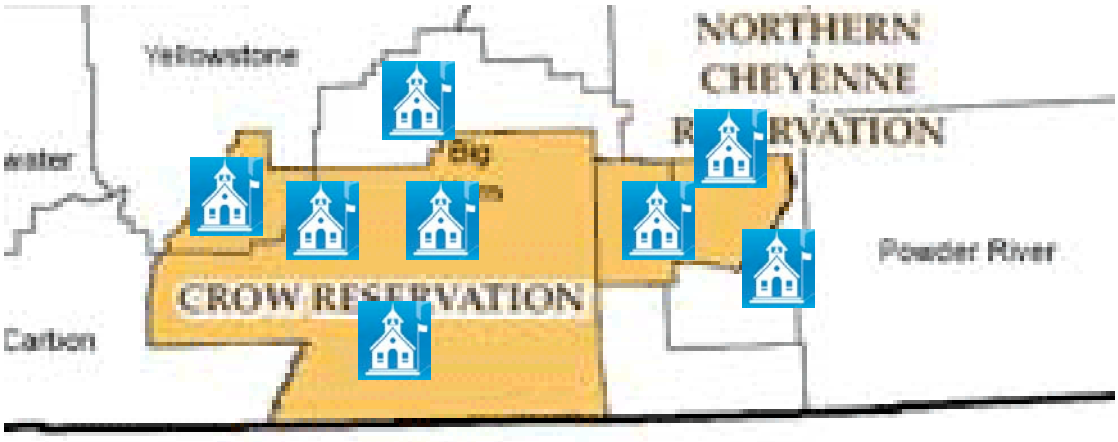
The data for this study was gathered during the first year of professional development offered by BSSP in part to gauge participants' current science teaching practices, and factors influencing these. An equally important reason for this study was to better understand science's traditional status as a "leftover" subject area that is under-emphasized in the elementary curriculum in terms of time devoted to instruction and attention to current reform teaching strategies (Smolleck, 2007). This research explored how much time teachers of K-6 students on or near the American Indian reservations spend teaching science, how they use that time, and the factors that influence their decisions about science teaching time and practice. These decisions take place in the contexts of the teachers' schools, the reservation communities where the schools are located, the students' academic performance, and professional development opportunities the teachers have recently or are currently participating.

The Schools

The ten teachers who participated in this study teach in schools that are public, private, and Tribal and fall under different accreditation standards. The public schools

are all defined as "in need of improvement" by the Montana Office of Public Instruction (OPI) based on their mathematics and reading scores. The schools in this study have math scores that range from 11% to 47% proficient and from 41% to 66% for reading (Figure 1). All the schools have been identified for "corrective action" and additional time is devoted to instruction in the targeted subjects. The private (Catholic) and Tribal schools are not required to follow the same test taking procedures as the public schools, and data on their performance on state testing and adequate yearly progress is not available.

Figure 1: Map of research area with approximate location of schools targeted by BSSP



= School in study

Map adapted from: http://www.opi.mt.gov/pdf/indianed/resources/americanindians101.pdf

While the schools in this study have been targeted for improvement based on testing, they are successful on many fronts including a teaching force that is considered "Highly Qualified." All the schools in this study have 100% compliance with the "Highly Qualified" stipulation, additionally the teachers in these schools have an average

longevity of 15 years in the schools with a range in the profession from five to thirty years, indicating a stable teaching population, and they have been identified by their administrators and through the BSSP application process as “have a passion for science “ and meet all, or most of, the nine attributes of teacher leaders identified by York-Barr, and Duke (2004) (BSSP Proposal, 2006).

The Reservations

The schools contributing teachers to this study are on or near the Crow and Northern Cheyenne American Indian Reservations in south central Montana. The Crow Reservation is the larger of the two and is located directly to the west of The Northern Cheyenne Indian Reservation. Both of these areas are geographically isolated from larger urban areas in the state of Montana (Figure 2). The region addressed by

Figure 2: Map of Montana showing all reservations with area of research specifically indicated.



Map above adapted from:
http://www.opi.mt.gov/pdf/indianed/resources/americanindians101.pdf

this study is in the south-central to southeastern part of the state and is indicated by an oval around the two American Indian Reservations in that area. Both reservations have levels of poverty that exceed other areas of the state with over 33 % of the Crow on the reservation living below poverty and about 40 % of Northern Cheyenne who live on the reservation living in poverty (State of Montana, 2008). The percentage of the population that contribute students to these schools is similar, with the percentage of the population living below the poverty level almost twice the average for the state (US Census Bureau, 2000). While the communities tend to be economically depressed and the number of students participating in the Free and Reduced Lunch program ranges from 75% to 97.8% for schools on the Crow reservation and from 86.5% to 89.3% for schools on the Northern Cheyenne reservation (Montana Office of Public Instruction, 2008), they are rich in many other aspects. The cultural identities of both reservations are very strong with 85% of Crow having the Apsa'alooke (Crow) as their first language (Crow Tribe, 2008). The Northern Cheyenne do not have as high a percentage of native speakers as the Crow, but in 2006 through their Tribal College they established the Northern Cheyenne Language Immersion Camp. The Camp was sponsored by the college Cultural Affairs Department with financial Support provided a Rural Systemic Initiative (RSI) that focused on math and science (Northern Cheyenne Nation, 2006). During the camp students and teachers learned their language, the names of constellations in their language and engaged in other scientific activities (Northern Cheyenne Nation, 2006).

The Crow Tribe also has a well-established Tribal college with science faculty who, along with the state university systems, has developed outreach and continuing

education programs that weave Native science into both historical and contemporary Tribal contexts. Both colleges are staffed with content and cultural experts who continually collaborate with the schools and Tribal community members. This effort has resulted in a network of tribal professionals, elders and teacher leaders who act as resources for teaching science steeped in the cultural traditions of the Tribes. Additionally both colleges have used the pristine and rich environment found on the reservation to develop programs of study that meet the unique needs of the Native American population.

Native American Students

An achievement gap exists among students from different cultural groups in Montana. While a variety of ethnic and cultural groups reside in Montana, Native Americans comprise the largest non-European American cultural group with 6.4% of the overall population and 15.8 % of the school age population (U.S. Census Bureau, 2000). Native American students typically perform considerably below the national and state average in science on standardized tests. A review of the results of standardized assessments showed that Montana students perform well on the IOWA and NAEP assessments (National Center for Educational Statistics, 2002). However, when the most recent IOWA test score data are disaggregated by demographics, Native American students score significantly lower than average for all content areas. When looking at science for the previous seven years, white students in 4th grade outperform Native American 4th graders by an average of 9.6%, and in the 8th grade the gap grows to 15% (Montana Office of Public Instruction, 2008). While the performance of Montana's

Native American students in science is lower than desired, the results are similar to other student groups living in poverty. As with other economically disadvantaged student groups, Montana Native American students show incredible promise and Federal programs like Title I and Title VII are available through the schools. Title I provides for the academic achievement of the economically disadvantaged and title VII supports American Indian, Native Hawaiian, and Alaska Native education (Moran and Rampey, 2008). Test score data (See Table 1) used to document the achievement gap between

Table 1 Montana Student Results (Proficient) on 2001 - 2007 Science portion Iowa Test of Basic Skills grade 4 and 8.

	Year	Grade 4	Grade 8
Native American Students	2001	52	46
	2002	55	44
	2003	52	48
	2004	56	51
	2005	54	46
	2006	50	47
	2007	50	45
White Students	2001	60	62
	2002	62	62
	2003	61	62
	2004	62	63
	2005	64	62
	2006	65	61
	2007	62	60
Free/Reduced Students	2001	52	55
	2002	60	55
	2003	61	55
	2004	62	58
	2005	60	56
	2006	60	54
	2007	57	53

Native and non-Native students and Native students and students in poverty in Montana is available from the Montana Office of Public Instruction (2008) and the National Center for Educational Statistics (2008).

In general Native American students in Montana graduate at lower rates then their white peers. Statewide Native Americans account for 71.9% of all drops outs from grades seven and eight, while making up only 11.5% of the enrollment for these grades (Montana Office of Public Instruction, 2007). When looking the drop out rate for High School, Montana Native Americans fair much better than their white peers, accounting for only 24% of all dropouts. According to the Montana Office of Public Instruction (2006) Montana's Native American students also have a higher rate of graduation, averaging 64.4% over the three-year period of 2002-2005. This is much better than the national average for Native American students which may be as low as 35% (Jackson, Smith, and Hill, 2003), and is typically reported to be only 51% (Orfield, Losen, Wald, and Swanson, 2004; NSTA 2005).

Big Sky Science Partnership

"Let us put our minds together, and see what life we will make for our children."
Sitting Bull (Tatanka lotanka) (1877)

As mentioned previously in this chapter, the teachers who participated in this study are all members of the first year cohort of the Big Sky Science Partnership (BSSP). The BSSP is the most recent project that is being provided as Montana State University Center for Learning and Teaching in the West (CLTW) and other providers of professional development work to build a vibrant and committed learning community of

grade 3–8 science teachers of teachers of American Indian students. Meaningful professional development designed to improve teaching is critical if Montana Native American students are to achieve at levels comparable to their white peers. Research suggests that Native American students do as well as their white counterparts when their teachers have sound pedagogical skills, expert content, and an awareness of their student's culture (Nelson-Barber and Trumbull-Estin, 1995; Bowman, 2003; Gordon, Stephans, and Sparrow, 2005). One way to provide this knowledge is to provide sustained (Darling-Hamond, 2000; Garet, Porter, Desimone, Birman, and Yoon, 2001), coherent (Feiman-Nemser, 2001; Garet, et al., 2001), and culturally relevant (Pewewardy, 2002) teacher development. According to the BSSP proposal (2006) this will be done through a partnership between the teachers and higher education science, science education faculty, and cultural consultants from tribal communities who will work in collaboration to increase their own understanding of science content, pedagogy and leadership for the purpose of improving science learning for American Indian youth in this and future generations. The BSSP on the reservations relevant to my research is building this community of partnership and learning on the foundation of earlier professional development projects from the CLTW. The initial projects in this effort, Chemistry by Inquiry, The Math Inquiry Group (MIG) and the Science Inquiry Group (SIG) were established more than five years ago during a time when the teaching of science and other subjects were being greatly reduced as a consequence of the recently adopted No Child Left Behind act (Pederson, 2007).

The BSSP is different from the earlier projects in the level of collaboration that

exists between higher education science and science education faculty and K – 8 teachers. In earlier projects, for example the SIG, science and science education faculty and staff from the CLTW provided monthly half day and full day science content and pedagogy workshops for K – 12 teachers who work on or near the two reservations of concern in this study. The BSSP is a much more structured collaboration involving science and science education faculty and staff from the CLTW, Montana State University – Bozeman, the University of Montana, and the lead institution, Salish Kootenai College, the tribal college of the Confederated Salish and Kootenai Tribes. This collaboration partnership depends on Tribal consultant partners, Tribal elders, who are keepers of tribes' traditional knowledge, and tribal scientists, who deal with contemporary reservation issues such as management of natural resources. These Tribal consultants, are particularly important as they partner with teachers and science and science education faculty to help them develop an understanding of tribal culture and reservation based issues.

Every tribal culture and reservation is a unique context, so each BSSP site works with the Tribal consultants to customize its science content and pedagogical activities to best meet the needs of the teachers in that specific situation (BSSP Proposal, 2006). In this study I worked with a group of 10 BSSP educators who teach on or near the Crow and Northern Cheyenne reservations. The teachers in this study have actively participated in all aspects of the first year of the BSSP. They each attended two weeks, 80 hours, of intensive Earth Science content and pedagogy woven into the cultures of both reservations during the summer of 2007. The two-week workshop was designed to

specifically target Montana Science Content Standard 4, "through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space" (Montana Office of Public Instruction, 2006, p. 9). This content standard relies heavily on inquiry as a key to successful teaching and calls for the use of inquiry processes, which are found earlier in the standards document. Inquiry, as defined by the Montana Science Content Standards is specifically seen as the ability to design, conduct, evaluate, and communicate the results and form reasonable conclusions of scientific investigations (Montana OPI, 2006). Demmert, (2001) goes on to say that practices found in inquiry, specifically observation, sense making, and collaboration align well with Native ways of knowing and help Native students see themselves reflected in the curriculum, making content important to them and validating their culture (BSSP Proposal, 2006).

The Montana Legislature has defined quality education to include Indian Education For All (Montana OPI, 2006). This means that in every subject area, including science, instructors are expected to not only have essential understandings about Montana Indians, they are required to integrate native ways of knowing into their content. This led to the development of Benchmark Six for Montana Science Content Standard One: observation of nature forms an essential base of knowledge among the Montana American Indians (Montana OPI, 2006, p. 4). It is now essential for Montana teachers of Native American students to participate in professional development activities that not only enhance their ability to integrate knowledge of science content, curriculum, learning and teaching, but also to tie this learning to the unique Native culture students bring to

the classroom. Training that provides teachers with the skills needed to tailor learning situations to the needs of individuals and groups from diverse cultural backgrounds has been found to be effective in several research studies. Studies by Zwick and Miller (1996) and Haukoos and LeBeau (1992) have shown that the ability of teachers to blend content knowledge and pedagogical content knowledge with cultural considerations has the potential to improve teaching and student learning. Improvements in teaching and increased student learning are both important aspects of a successful professional development programs (Darling-Hammond, 1998; Feiman-Nemser, 2001) and are the primary goals of the BSSP.

Following of the foundations established during the summer workshop in September of 2007, the BSSP teachers began to meet for monthly one or two day content sessions at various reservation and statewide venues. Many of these sessions tied directly to a graduate level Earth Science course they were taking, while other sessions involved culture immersion and BSSP specific sessions at the state teacher convention. The blending of content and culture within the BSSP sessions follows the recommendations of Bowman (2003), Cajete (1994), Demmert (2004), Nelson-Barber and Estrin (1995), Pewewardy (1998), and Pewewardy and Hammer (2003) who believe that conveying subject matter within the context of familiar cultural experiences, local values, shared communicative norms, and interactive styles has the potential to bridge the cultural incongruities of American schools with Native cultures. As the BSSP moved through the fall and into the spring session, staff continued to tailor instructional methods and content to be more compatible with Native students' learning preferences.

The BSSP teachers kicked off the spring 2008 sessions with two and a half days of Math and Science Leadership and Indian Education for All and the addition of an online component to the second semester of their graduate level Earth Science course. As in the fall, the teachers in my study continued to participate in monthly one or two day content sessions at various reservation locations and began to prepare to build their teaching portfolios as part of their participation in the BSSP. In March of 2008 I recruited the participants in my study from the active BSSP teachers. By the end of the 2007 – 2008 teaching year, year one of the BSSP, the teachers in this study had completed over 200 hours of Earth Science content and culturally relevant pedagogy Bowman (2003) that leads to culturally responsive teaching (Gay, 2000).

The problem of Native American achievement is complex and involves many influences including schools, communities, and state and national legislative mandates. This complex situation requires what Spraker (2003) suggests are complex solutions that go far beyond changing the teaching practice of individual teachers. While the problem is complex and true sustainable change will involve many dimensions, the teaching practice of individual teachers is a starting point.

Improving the quality of education for Native American students is a multifaceted problem. The scope of this research is limited to two facets of this problem, classroom practice and the influences that drive that practice.

The Purpose of This Study

The purpose of this descriptive study was to document the amount of teaching

time devoted to science for ten K–6 teachers from schools on or near two Montana American Indian Reservations. In addition to the amount of time spent teaching science, this study uncovered how the teachers use this time, the factors that drive these choices, and how well they integrate culture elements into their teaching of science.

Research Questions

This research examined the following focus questions:

1. *How much time are elementary teachers able to devote to teaching science and how is this time distributed?*
2. *When the teachers are teaching science, how do they use the time?*
3. *What influences guide the teachers' decisions about how often to teach science and how they use the time?*

Significance of Study

There are several areas in which this study can provide significant contribution to the research. Previous research (Jones, et al., 1999; Fulp, 2002; and McMurrer, 2007) indicate that science is taught infrequently or not at all (Dorph, et al., 2007) in many elementary classrooms, and the lack of time devoted to teaching science coupled with the topics that are covered and the teaching strategies used in these abbreviated programs often result in inadequate science learning opportunities for students. This study explored this situation in the context of high needs schools where the pressures are great on administrators and teachers to skew the curriculum toward subject areas like English

language arts (reading) and mathematics (McMurrer, 2007; Dorph, et al., 2007; and Smolleck, 2007) upon which the districts' funding, accreditation and autonomy will depend. The study also provided a deeper understanding of the teaching circumstances of teachers working on or near two Montana Indian Reservations through teacher artifacts, survey instruments, interviews and classroom observations. Classroom observations, while limited to only one per teacher during this study, had the potential to add to much needed observational data from Native American classrooms called for by Demmert (2001) and Strang and von Glatz, (2001) who feel that the collection of observational data will help establish a baseline of prevalent practices in schools with high percentages of Native Americans.

Woolbaugh (2004), in his research with science teachers who teach on and near the Northern Cheyenne and Crow Reservations, helped provide some baseline data as called for by for by Strang and von Glatz (2001). Classroom observations can also have a developmental effect of enhancing the quality of teaching as teachers prepare to be observed (Hatzipangos and Lygo-Baker, 2006). Woolbaugh's (2004) research provided a starting point for the development of several of the recent professional development efforts (SIG and BSSP) when he called for sustained professional development for teachers working on or near these two Montana American Indian Reservations. This call also aligns with a primary goal of the CLT-West to focus on the creation of professional development programs for science teachers' that improve engagement and learning for high need students. The first contribution from this study was the collection of a variety of teacher and classroom data from classes that contain predominantly Native

American students. Analysis of this data, built on the work of Woolbaugh (2004) adds to the base of data on classroom practice for schools that have high percentages of Native American students.

Limitations of the Study

There are several limitations of this study. First, the study focused on a limited number of teacher participants from two Montana Indian Reservations. A small sample means that data was collected from only a small sample of classrooms, thus making it more difficult to generalize results to a broader population. In addition to the small size of the sample, for two portions of the data collection it was necessary to rely on volunteers and this may have skewed the data. Second, the period of time available for the collection of data was tied to the school calendar and occurred during the spring of 2008. One instrument was limited to an eight-week window during this period and may have influenced results. Data from classroom observations was limited due to difficulty in matching time limitations, school schedules, and the geographical distribution of the schools to the availability of trained observers. Data from observations provided only a few points of color, one point for one day in one classroom. As more observations are made in the future the picture builds into more than isolated points of color and general patterns will be revealed. However, it was beyond the scope of this research to paint the whole picture of teaching on a Montana Indian Reservation. Despite the above limitations, classroom observation provides a unique opportunity for an observer to see and analyze what teachers and students are actually doing (Fullerton, 1999). One last

limitation of the study was its primary dependence on teachers' self reported data. Many of the data sources involve teachers perceptions of their own practices rather than the observation of an outside observer, which according to Lumpe, Haney, and Czerniak (2000), are not necessarily consistent with the literature about best practice in teaching.

Definition of Terms

A number of terms, which require description and definition, are used throughout this paper.

Achievement Gap: Refers to the disparity in academic performance between groups of students. It is most often used to describe the troubling difference in academic performance between underserved and disadvantaged students and their white peers and shows up in grades, standardized test scores, and dropout rates (Barton and Coley, 2008).

Content: The subject matter to be known and learned. In science this would include the study of the natural world.

Critical Thinking: The mental process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information to reach an answer or conclusion through content-specific critical inquiry by the individual learner.

Culturally Responsive Teaching: Education for children that preserves their own cultural heritage and prepares them for meaningful relationships with other people, and for living productive lives in the present society without sacrificing their own cultural perspective Pewewardy (1994).

Learning: To gain knowledge, comprehension, or mastery through experience or study that results in a relatively permanent change in behavior or understanding.

Pedagogical Content Knowledge (PCK): The combination of knowledge of pedagogy and knowledge of content. The teacher of science understands the central ideas, tools of inquiry, applications, structure of science and the science disciplines he or she teaches and can create learning activities that make these aspects of content meaningful to students. Teachers understand the central concepts, tools of inquiry, and structures of the discipline they teach (Interstate New Teacher Assessment and Support Consortium, 2002; Shulman (1987).

Pedagogical Knowledge: Pedagogical Knowledge is the ability of the teacher to understand how learning occurs--how students construct knowledge, acquire skills, and develop habits of mind--and how to use instructional strategies that promote student learning. It is more than simply understanding teaching. It is what Shulman (1987) describes as the exchange of ideas in which the teacher takes a concept from the content area and molds it into a form that the students can understand.

CHAPTER TWO

LITERATURE REVIEW

This literature review is composed of several sections of importance to the purpose of this study. The first section examines research related to science teaching time. The second section focuses on visions for and the practice of science teaching, including science content and instructional practice, examined through the research and policy literature. The third section examines the literature on teaching and learning approaches shown to be effective with Native American students. The visions of good science teaching presented in section two and three allow for later comparisons between these ideals for use of science teaching time and the teaching practice reported and observed in this study. The fourth major section of the chapter provides an overview of research of influences on teachers' instructional decisions.

Allocation of Teaching Time

Even before the current legislative drive to emphasize tested academic content and skills, The National Education Commission on Time and Learning (1994), in their report *Prisoners of Time*, concluded that higher standards will translate into more school time devoted to mastering the higher standards in traditional academic subjects such as English, mathematics, and science. Sorenson and Hallinan (1977), consider teaching time a school resource that, according to how it is used, will provide different opportunities of learning for students. This resource can be allocated and measured in several ways.

Indicators for teaching time range from the number of days in the school year to the number of hours spent on a single curricular subject (Baker, Fabrega, Galindo, and Mishook, 2004). These authors comment that it is often difficult to precisely measure the amount of time actually spent in instructional tasks because the school day is rife with interruptions and non-teaching expectations that all consume the instructional time available to the teacher. However, even with the inherent difficulty in measuring teaching time precisely, there have been several cross-national studies over the last twenty years that have attempted to look at teaching time as part of their broader effort to compare national educational systems.

International Comparisons

Since the late 1980's there have been two major comparative studies of educational achievement that specifically look at instructional time in science. These are the Programme for International Student Assessment (PISA, 2000) and the Trends in International Math and Science Survey (TIMSS, 2003, 2007), which are cross-national studies of achievement, schools and family background. PISA tested mathematics, science and reading for 15 year olds in 30 countries. While this test addressed a student population that is not the focus of my research, it is interesting to note that 15 year olds (10^{th} grade equivalent) in the United States averaged 4.5 hours of science per week, only slightly behind Canada and Spain at 4.6 hours per week. The United States placed fourth for average number of hours for the 30 countries in the study, with Mexico having the

highest number of instructional hours in science, 5.1, followed by Hungary at 4.9 hours per week (Benavot and Amadio, 2004).

TIMSS is the latest assessment in a series of international studies conducted by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS assessed fourth and eighth-grade students from 38 nations to measure trends in student achievement both in mathematics and science. The goal of TIMSS was to provide better understanding of the interplay between the intended, implemented and attained curriculum and the effects on achievement (Baker, et al., 2004). The TIMSS instruments have tested a variety of grade levels over the years, with grade four being included in the majority testing cycles. Since this grade falls within the grade range of interest to my study, I will be looking at the fourth grade data from this instrument in greater detail in the next section.

TIMSS

The TIMSS, first conducted in 1995, is a project of the IEA, an independent international cooperative of national research institutions and government agencies that has been conducting studies of cross-national achievement since 1959 (Martin, Mullis, Gonzalez and Chrostocski (2004). Prior to the TIMSS, the IEA conducted the First International Mathematics Study in the early 1960's and followed this with the Second International Mathematics Study in the late 1970's. After the initial 1995 TIMSS study there have been regular follow-up implementations on a regular four-year cycle with the most recent in 2007, providing countries with an unprecedented opportunity to obtain

comparative information about their students' achievement in mathematics and science. TIMSS 1995 compared the mathematics and science achievement of students in 41 countries at five grade levels including third, fourth, seventh, and eighth grades, as well as the final year of secondary school. TIMSS 1999 included 38 countries (26 from the 1995 study). The assessment measured the mathematics and science achievement of eighth-grade students (ages 13 and 14 years) and also collected extensive information from students, teachers, and school principals about mathematics and science curricula, instruction, home contexts, school characteristics and policies (Martin, Mullis, Gonzalez, Gregory, et al., 2000). Since the TIMSS 1999 study only looked at grade eight students I will not be including data from this administration in my research. TIMSS 2003 was administered at the eighth and fourth grades in 49 countries, 23 of which participated in TIMSS 1995 and TIMSS 1999, providing three testing cycle at the eighth grade and for two testing cycles at the fourth grade (Martin, et al., 2004). The 2007 iteration of TIMSS included 59 countries, 23 of which have fourth grade data that can be compared to earlier TIMSS administrations. Since the 1995, 2003 and 2007 studies include data for the grade range of interest in my study, I used data from these three administrations of the TIMSS.

TIMSS Purpose

The purpose of the TIMSS study is to measure science achievement and summarize student performance. The instrument is designed to measure a wide range of student knowledge and proficiencies. TIMSS established four performance benchmarks, working with the international Science and Mathematics Item Review Committee to

describe student performance for these benchmarks (Martin, et al., 2004). In addition to the measurement of achievement in science, the TIMSS documents also included a background questionnaires that describes the contextual factors associated with students' learning in mathematics and science. In particular, this survey looks at classroom activities, specifically the amount of time allocated to the teaching of science and what that teaching looks like. Martin, et al. comment that when comparing achievement across countries, it is important to consider differences in students' curricular experiences. They say that students' opportunity to learn the content, skills, and processes tested depends largely on what their teachers choose to teach them. The lessons provided by the teacher ultimately determine the science students are learn, often more so than the curricular goals and intentions inherent in each country's policies for science education (Martin, et al.).

TIMSS Background Questionnaire Construction

TIMSS collects extensive information about the contexts for learning mathematics and science by administering multiple background questionnaires. Four types of background questionnaires were used in TIMSS 2003 and 2007 to gather information at various levels of the educational system. The questionnaires of importance to this study are the teacher questionnaires that asked mathematics and science teachers of the students tested about their preparation to teach, their teaching activities and approaches, their attitudes toward teaching the subject matter, and the curriculum that is implemented in the classroom (Chrostowski, 2004). The teacher questionnaires were designed through a

multi-year process that brought together TIMSS National Research Coordinators and experts in mathematics and science content and pedagogy to establish a contextual framework that would help researchers understand the learning environment that exists in classrooms around the world. The contextual framework that emerged included three main areas of interest to the TIMSS team: teacher pre-service training, professional development, and technology use. In addition to these research foci, a section of the teacher questionnaires was specifically designed to elicit responses about classroom activities and characteristics. This section of the TIMSS teacher questionnaires is of particular interest to this researcher since there are questions that pertain to aspects of the implemented curriculum that are most closely tied to the research questions of this study. This section of the questionnaires includes questions that specifically address the amount of classroom time devoted to mathematics and science instruction. Additional questions of interest that will be addressed in later sections of this chapter center on the enacted or actual curriculum taught and the pedagogical approaches used to deliver the content.

In order to check across participating countries to determine if the questionnaires were actually measuring what they were designed to measure, field tests were conducted for both the fourth and eighth grade versions of the teacher questionnaire. For the fourth grade, 20 of the 26 TIMSS 2003 countries participated in the field test, and 41 of 48 countries participated at the eighth grade (Chrostowski, 2004) field test. Based on the results of these field tests, review by TIMSS National Research Coordinators, and input from the International Study Center the instruments were finalized and packaged with other TIMSS assessment instruments for distribution to participating countries

(Chrostowski, 2004). Similar information about the construction of the 2007 TIMSS was just been released and mirrors previous versions of the instrument (Foy, and Olson, 2009).

TIMSS Teacher Questionnaires Sample

TIMSS collects data not only on academic performance of students but also a variety of information and data from numerous questionnaires. Of primary interest to this research is the teacher questionnaire for fourth grade because it asks several questions that are particularly relevant to this study. Teachers are asked to estimate the number of minutes per week that they spend on science topics with the fourth-grade students in the TIMSS class, as well as establishing an approximate percentage of teaching time that they spend during the past school year on life science, earth science, physical science, and other science topics studied by the fourth-grade students in the TIMSS class. The TIMSS teacher questionnaire also asks teachers to reflect on their science teaching and judge how much time they have their students participate in various science activities including working in groups, watching demonstrations, and participating in laboratory explorations.

According to Foy and Joncas (2004), the target population for all countries is known as the international desired population. For the TIMSS 2003 study there were two target populations of interest, and countries were free to participate in either population category or both. The international desired populations for TIMSS were the following:

> Population 1: All students enrolled in the upper of the two adjacent grades that contain the largest proportion of 9-year-olds at the time of testing. This grade level was intended to represent four years of schooling, counting from the first year of primary or elementary schooling, and was the fourth grade in most countries.
>
> Population 2: All students enrolled in the upper of the two adjacent grades that contain the largest proportion of 13-year-olds at the time of testing. This grade level was intended to represent eight years of schooling, counting from the first year of primary or elementary schooling, and was the eighth grade in most countries (Foy and Joncas, 2004, p 110).

There was the expectation that all participating countries would define their national desired populations to resemble one or both of the TIMSS definitions, each country would include at least 95 percent of the national desired population in their own sample population (Foy and Joncas, 2004). Based on this standard, the idea was then to sample intact classrooms because that allows the simplest link between students and teachers. Since teachers are the focus of the research in my study, this is the level of the sample that is of interest. While my focus is at the teacher level, it is important to note that TIMSS requires a minimum of 4,000 students for each target population to ensure adequate sample sizes for sub-groups categorized by school, class, teacher, or student characteristics. While student population is essential to the TIMSS study, it is the minimum number of schools and classrooms that fits the needs of my research questions. For viable analyses at the school and classroom levels, TIMSS deemed it necessary to have at least 150 schools selected from each target population. For the United States this target of 150 schools provided 921 teacher questionnaires (Kastberg, Roey and Williams, 2005) at the fourth grade level for TIMSS 2003. The TIMSS 2007 target population consisted of all students enrolled in the fourth year of formal schooling as defined by

the United Nations International Standard Classification for Education (Martin, Mullis, and Foy, 2008). TIMSS 2007 was based on a scientifically-selected random sample using WinW3S sampling software that allowed national coordinators more flexibility in selecting participating schools than TIMSS 2003 while still providing samples of 150 schools per country for assessment (Martin, Mullis, and Foy, 2008).

TIMSS Teaching Time Results

There is almost always a difference between the intended curriculum and enacted or actual curriculum, and TIMSS has looked at both of these with respect to science teaching time. Background survey data available from the 2003 and 2007 studies indicate that, in general, countries designate in their intended science curriculum as a percentage of total instructional time that should be devoted to science at different grade levels. The percentage of instructional time recommended for science in TIMSS 2003 ranged from 4 to 20 percent at second grade, from 4 to 28 percent at fourth grade, from 5 to 28 percent at sixth grade, and from 7 to 32 percent at eighth grade, with no specific indication given by the United States at any grade level (Martin, et al, 2004).

When investigating instructional time actually devoted to science, comparisons are based on responses to the questionnaire completed by teachers whose students are tested by TIMSS and reported in terms of the average number of hours of science instruction over the school year rather than as a percentage. At the fourth grade, countries devote less instructional time to science than at the eighth grade, both in terms of the total instructional hours and the percentage of time devoted to instruction. According to

TIMSS 2003, total instructional time during a typical school year for science ranged from 33 hours in the Russian Federation to 176 hours in the Philippines, with the United States devoting 95.2 hours (8.8%) of teaching time to science instruction. The figure for the Philippines was almost twice that for the next highest, the Canadian province of Ontario (93 hours). The percentage of instructional time at the fourth grade that was devoted to science ranged from 3% in Netherlands to 16% in the Philippines (Martin, et al., 2004). When looking at the eighth grade, the United States comes in second to the Philippines with 135 hours (13%) devoted to science instruction. Among countries teaching science as a single subject in the eighth grade, instructional time ranged from 69 hours (7%) in Italy to 202 (18%) in the Philippines, with an international average of 117 hours or 12% of teaching time devoted to teaching science (Martin, et al.). TIMSS 2007 indicated that fourth grade teaching time ranged from 24 hours in Georgia to 145 hours in Columbia, with the United States devoting 100.4 hours (9.3%) of teaching time to science instruction (Foy and Olson, 2009).

TIMSS Summary

Based on data provided by teachers from at least 150 schools in the 49 countries participating in the TIMSS 2003 study the following can be said about teaching time. For the eighth grade, students in countries with separate science subjects had more instructional hours in the sciences. Annual hours of science instruction ranged from 284 hours in the Slovak Republic, where students take biology, chemistry, physics, and earth

science simultaneously, to 69 hours in Italy, where science is taught as a single, integrated subject. The United States comes in second to the Philippines with 135 hours of science instruction, equivalent to 13% of total instruction, among countries teaching science as a single subject. Assuming a typical 40-week school year, 135 hours equates to about 41 minutes of science instruction per day for grade eight students in the United States. When looking at science teaching in the fourth grade, overall there was less instructional time for science, with annual hours ranging from 176 in the Philippines to 33 hours in the Russian Federation, with the United States devoting 95.2 hours (8.8%) of teaching time devoted to science instruction. For a typical 40-week school year, 95.2 hours equates to about 48 minutes of science instruction per day for grade four students in the United States. TIMSS 2007 results were very similar for the United States with an average of 100.4 hours (9.3%) of teaching time devoted to science. Based on TIMSS 2003 data, the United States tied with Chinese Taipei for second at the fourth grade, indicating that while science takes only 8% of all teaching time, the Unites States devotes considerably more time to teaching science than most other countries in 2003. However, for the TIMMS 2007 the United States fared less well than in 2003 with 12 of the participating countries devoting more time to science teaching on a yearly basis.

A Global Study of Intended Instructional Time

Benavot and Amadio (2004), in their global study of intended instructional time, looked at collections of official educational sources, mostly compiled by the International Bureau of Education (IBE), to understand global and regional patterns for intended

instructional time. In addition to looking at the hours each country devoted to teaching science, they were also interested in the prevalence and relative emphasis given to various curricular subjects in grades one through eight during the 1980's and the early years of the twenty-first century.

Methodology for a Global Study of Intended Instructional Time

The findings of Benavot and Amadio (2004) on annual instructional time are based on an international database prepared by the International Bureau of Education (IBE). The estimated figures assess, as carefully as possible, the number of hours that students were expected to be present in formal, school-based learning situations. In calculating the intended yearly hours of instruction for each country, three components were taken into account:

1) the duration of the 'working' school year, expressed as the number of days or weeks that schools are open and classroom instruction is taking place;

2) the number of teaching 'periods' (lessons, or instructional 'hours') allocated to each subject in each grade level as specified in official curricular timetables or other curriculum-related documents; and

3) the average duration of 'periods' (lessons or 'hours'), expressed in minutes (Benavot and Amadio, 2004, p 8).

While information on the last two components is relatively precise in national documents and reports, there are problems determining the exact number of working days or weeks in a typical school year. This difficulty lies in the fact that most school systems devote certain days, parts of the academic year, or teaching periods during a day to state and national examinations, teacher in-service training and professional development, in-school holiday celebrations or extra-curricular activities which cut into the actual time

available for teaching. These disruptions are often not are included in official reports of "working weeks" (Benavot and Amadio, 2004). These authors report that they made sustained efforts to verify, and subsequently revise, national figures on the actual number of working school days or weeks for each grade level, and wherever possible they deleted time from their estimates of intended instructional time for daily or weekly breaks and recreational activities that they found reduced actual intended instructional time.

Benavot and Amadio (2004) report that the reliability of instructional time data for the early 2000s is significantly better than that for the 1980s. The main reason for this is the use of a single source of data compilation (IBE) for the 2000's data rather than multiple sources. They also attribute the increase in reliability to increased detail and precision of official national documents from the countries in the study, and the ability to cross-check questionable figures by examining national sources via the Internet as well as through personal contacts with official authorities. However, there were several "problematic" cases that were dropped from the analyses due to unclear or grossly imprecise figures, usually for the 1980s (Benavot and Amadio, 2004). Finally, in analyses of over-time comparisons, only countries with instructional data for both time were included. According to these researchers this constant case base was used in order to enhance the validity of the conclusions.

Sample for a Global Study of Intended Instructional Time

For Benavot and Amadio's 2004 study, hundreds of official timetables from numerous countries were identified and divided by historical period, either 1980s or

2000s, and then coded according to a set of standard procedures and rules. These rules followed schemes developed by the United Nations and the World Bank that specified how to code all subjects listed in the timetables. These rules specified how to code combined subjects, interdisciplinary subjects and electives, and also how to deal with timetables accommodating regional, linguistic, cultural or religious differences. Benavot and Amadio (2004) comment that during the coding process, instructional time for grade level one through eight and for all curricular subjects and educational activities were allocated into a basic classification scheme of 10 subject areas common to the majority of countries reporting data. These authors state that while the subject areas of language, mathematics, science, social studies, and others have uniform names, they warn readers that the data sources and coding scheme do not provide information about the actual contents behind the labels listed in the official timetables. After completing the coding of official timetables, Benavot and Amadio (2004) constructed three variables for cross-national and longitudinal comparisons:

1) a dichotomous variable based on whether a subject (area) was (or was not) taught in an official timetable. This variable enabled us to estimate the proportion of countries in the world (or geographical region) that require instruction in a specified subject area;

2) a ratio variable based on the percentage of total class periods or instructional hours that were allocated to each subject area in the timetable. This variable estimated the percentage of total instructional time allocated to different subject areas i.e., the relative emphasis/importance of different subject areas in the official curriculum;

3) an interval variable based on the number of yearly hours of instruction devoted to each subject area, per grade level or educational level (primary, lower secondary, upper secondary). This variable estimated the quantity of annual instructional time that students are expected to study a subject area (Benavot and Amadio, 2004, p 10 - 11).

Global Study of Intended Instructional Time Results

Benavot and Amadio (2004) looked at individual countries when they compiled their data. However, when reporting the data they used United Nations regions to give a broader picture. They group countries according to geographical and geo-political associations. The groups are Latin America and Caribbean, East Asia and the Pacific, Sub-Saharan Africa, Arab States, South and West Asia, Central and Eastern Europe, North America and Western Europe, and Central Asia (Benavot and Amadio, 2004). When looking at the data, they observed global patterns for annual instruction time in grades one through eight in both the 1980s and 2000s. The descriptive statistics found in Table 2 are based on a constant set of cases at each grade level in order to enhance the validity of comparisons over time (Benavot and Amadio, 2004). The data in this table reveals that these countries mandated a little over 700 hours of total instructional time in each of the first two years of primary education. This was consistent in both study periods. Additionally the table indicates that for both periods of time, as the students mature, the intended instructional time increases in each subsequent grade level. In the 2000s, by the time students reach fourth grade, they participate in approximately 800 hours of school annually and about 900 hours annually by eighth grade. This pattern translates into an average supplement of about 25 annual instructional hours per grade level, although these increases are not linear. There are significant jumps during grades 3-5 and then again between grades 6 and 7 when the transition between primary and lower secondary education typically occurs. With few exceptions, these global patterns in

Table 2: Yearly Instructional Time in Primary and Lower Secondary Education, Worldwide, circa 1985 and 2000, Constant Cases by Grade Level*

Period		Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Circa 1985	Mean	722	733	773	803	831	853	896	909
	Median	708	717	761	803	828	840	888	893
	25 percentile	620	623	675	712	750	765	831	833
	75 percentile	833	833	875	890	912	935	974	992
	S.D.	140	138	122	119	116	112	116	117
	C.V.	.194	.188	.158	.148	.140	.131	.129	.129
Circa 2000	Mean	722	732	769	790	819	831	902	907
	Median	741	743	784	798	809	813	900	900
	25 percentile	595	630	674	720	733	755	809	833
	75 percentile	810	815	850	862	900	903	972	990
	S.D	134	129	124	114	112	109	129	120
	C.V.	.186	.176	.161	.144	.137	.131	.143	.132
Constant Cases		88	88	88	88	86	82	73	71

* all figures have been rounded off. S.D. refers to the standard deviation of the reported mean and C.V. refers to the coefficient of variation, which is calculated as the standard deviation divided by the mean. Table adapted from Benevot and Amadio (2004).

instructional time by grade level are found in both time periods, regardless of the estimation procedure employed (Benavot and Amadio, 2004).

When looking at the amount of teaching time by subject area (Table 3), there are two areas that globally take the greatest percentage of time and are universally required in grade levels one through eight. These two core curriculum areas are language and mathematics, and during the 1980's, data indicate that these two subject areas took about 56% of all time available during the first three years of schooling. During the same time period, language and mathematics took an average of 47.8% of teaching time in grades

four through six, and 43% in grades seven and eight. When looking at the amount of teaching time for the 2000s, the amount of time devoted to language and mathematics increased by slightly more than 3.5% to 59.6 % of all time allocated during the first three years of schooling. For grades four through six, the time devoted to language and mathematics increased 4% to an average of 51.9% of teaching time. For seventh and eight grade, the allocation of time for these subjects increased very little and was roughly 44% of all teaching time.

Table 3: Relative Emphasis on Major Subject Areas in Official Curricula, Worldwide, by Grade level, 1980s and 2000's, and percentage of total instruction time allocated to major subject areas (adapted from Benavot and Amadio 2004).

General Subject Areas	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
All Language Instruction 1980's	38.4	37.6	34.5	32.6	31.4	30.7	29.2	28.7
Mathematics 1980's	19.4	19.4	18.7	17.8	17.3	16.7	14.2	13.3
Sciences 1980's	4.3	4.6	6.4	7.3	7.9	8.8	11.5	12.3
Number of Countries 1980's	83	84	83	83	81	77	74	70
All Language Instruction 2000’s	40.9	40.7	38.6	36.4	34.9	33.5	30.7	29.4
Mathematics 2000’s	19.8	20.2	19.4	18.8	17.6	14.7	14.2	13.9
Sciences 2000’s	3.7	3.8	5.3	6.3	7.4	8.8	12.1	14.1
Number of Countries 2000's	108	108	108	108	110	110	108	105

In addition to the time dedicated to language and mathematics, Benavot and Amadio (2004) found that the vast majority of countries require instruction in the sciences, and there is a gain in prominence in the curricular guidelines dealing with science in the upper gradehas decreased in grades one through five in the 2000’s. The

data indicated that there was no change in the percentage of time for science teaching in grade six from the 1980s to the 2000s while there was a small increase of 0.6%

Table 4: Average science teaching time in hours, by grade level and time period.

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Sciences Average Hours	31	33.7	6.9	58.6	65.6	75	103	111.8
Number of Countries 1980's	83	84	83	83	81	77	74	70
Sciences Average Hours	26.7	27.8	40.7	49.8	60.6	73.1	109.1	127.9
Number of Countries 2000's	121	121	122	121	123	121	110	107

or roughly four and a half hours more science teaching time for the seventh grade between the 1980s and the early 2000s. The gain for the eighth grade was 1.8% or an increase of about 16 hours a year. Table 4 (above) provides additional detail regarding the distribution of science teaching time for the two time periods in the Benavot and Amadio study. Percentages have been converted to hours per year for science teaching.

Global Study of Intended Instructional Time Summary

Benavot and Amadio's report examined two key aspects of the structuring of children's school-based experiences: first, the amount of instructional time countries expect pupils to be in school, and second, the organization of the school curriculum, which reflects official policies of how intended time should be organized according to curricular contents and school subjects. Based upon an extensive compilation and systematization of official reports submitted by national ministries of education to the International Bureau of Education since the 1980s, this report focused on global, regional

and longitudinal patterns of intended instructional time as well as the prevalence of, and relative emphasis on, curricular subject areas in primary and lower secondary education (Benavot and Amadio, 2004).

Teaching Time in the United States

The proportion of time that elementary school teachers use to teach science is an important aspect of instruction (Perie, Baker, and Bobbitt, 1997). While science is not allocated as much time as reading/language or mathematics, it remains one of the core subjects at the heart of the school curriculum in the United States, and the proportion of time spent during the school day teaching science to young students reflects the emphasis schools place on science among the academic core topics. The following section of this chapter measures science teaching time from a national perspective focusing on the United States.

National Assessment of Educational Progress (NAEP)

The NAEP, also referred to as The Nation's Report Card, has been used since the 1970's to provide a snapshot of student achievement at grades four, eight, and twelve. The primary longitudinal data available from this series of yearly assessments focuses on language arts, primarily reading, and mathematics. As a portion of these assessments, a teacher questionnaire was used to provide supplemental information about the instructional experiences for the subjects in which the students are being assessed. My interest in this portion of the questionnaire is to look at the national trend in teaching time

for teachers of science prior to No Child Left Behind and since the introduction of that Legislation.

NAEP Methodology

In addition to the content assessment questions, the NAEP has developed questionnaires to provide information on the teaching practice and the time spent teaching various subjects including science. The process used to develop these questions, is what NAEP documents refer to as a consensual process that involves staff work, field testing, and review by external advisory groups. The issues, questions, and field-test results are reviewed by external consultants who identify specific questions to be included in the final questionnaires. NAEP item developers review all questions to ensure fairness and quality (NAEP, 2008a). Further review of the questions is then done by the National Center for Educational Statistics (NCES) and the United States Office of Management and Budget. According to NAEP (2008a), once the questions have been approved by NCES and the Office of Management and Budget, each question is included in the teacher questionnaire instrument.

Once the instrument was finalized, teachers of students being assessed by the NAEP in approximately 1,100 public and nonpublic schools in 52 states and jurisdictions were asked to complete the questionnaire in an effort to represent the nation as a whole (NAEP, 2008). According to NAEP (2008a), the response rates for teacher questionnaires for fourth grade was 97.1 % and 92.7% for eighth grade, indicating that the results are representative of teachers nationwide. Another instrument, The Schools and Staffing Survey (SASS), that provides insight into the time spent teaching science within the

United States has been used by NCES and is not given in association with a student assessment like the NAEP questionnaire and will be used in comparison to the NAEP results. The SASS will be discussed in further detail in a later section of this chapter,

NAEP Results

Prior to No Child Left Behind (NCLB), the NAEP and NCES data for science indicate that in the 1994 – 1995 academic year teachers at the fourth grade level had a range of time devoted to teaching science. The NCES (1997) Digest of Education Statistics, which were based on the 1993 - 1994 Schools and Staffing Survey (SASS) data, (Table 5) reports that 8% of fourth grade teachers spent less than one hour a week teaching science; 16% spent between one and two hours a week; 33% devoted two to three hours; and 42% spent three hours or more teaching science. By 2003, two years after NCLB legislation began to take effect, the NCES reported an average of 83 hours a year, roughly 2 hours per week for the typical 40-week school year for fourth grade science in the United States. The difference in reporting style is due to changes in how the questions were asked by the instruments and the interpretation of data by the reporting agencies. In 2005, four years after NCLB implementation, a comprehensive report of the status of science education in the United States was published by NAEP using data from teacher questionnaires and was included in the 2005 Nation's Report Card. This data (Table 5) indicated that for the fourth grade, 17% of teachers were spending between 1 and 1.9 hours a week on science instruction, 33% were spending 2 to 2.9, 26% devoted between 3 and 3.9, and 18% were spending four or more hours

teaching science each week (NCES, 2005). An interesting observation from the data is that there is essentially no difference in the percentage of teachers

Table 5: NCES 1997 and NAEP 2005 science teaching time data for 4th grade.

Pre NCLB 1997 NCES (SASS 1993-1994)		Post NCLB 2005 NAEP	
Hours per week	percentage	Hours per week	percentage
<1	8	no data	6
1 to 2	16	1 to 1.9	17
2 to 3	33	2 to 2.9	33
>3	43	3 to 3.9	26
		>4	18

reporting that they teach 1 to 2 hours, or for those reporting teaching between 2 and 3 hours between the NCES and NAEP reports. There is also a similarity in the data when one combines the percentages of teachers reporting teaching science 3 to 3.9 hours per week and those reporting more than four hours (44%) for NAEP 2005, which compares to the percentage of teachers reporting more than three hours of science teaching each week (43%) on the NCES 1997. The NAEP 2005 reported for the eighth grade (Table 6)

Table 6: NAEP 2005 science teaching time data for 8th grade.

2005 NAEP (SASS 2003-2004) 8th Grade Results	
Hours per week	percentage
no response	2
0 to 2.9	4
3 to 4.9	57
5 to 6.9	23
>7	14

with 4% of teachers, indicating that they spend less than 2.9 hours a week teaching

science, 57% teaching between 3 and 4.9 hours, 23% devoting 5 to 6.9, and 14% providing 7 hours or more to teaching science each week (NAEP, 2005). It makes sense that the majority of eighth grade science teaching is in the range of 3 to 4.9 hours per week since most students in the United States take their science in periods of roughly 45 to 55 minutes daily.

The Schools and Staffing Survey (SASS)

The SASS, mentioned briefly in the previous section, is a comprehensive survey of teachers that provides a large dataset for both public and private elementary and secondary schools in the United States. SASS has collected data over five different school years: 1987 - 1988, 1990 - 1991, 1993 - 1994, 1999 - 2000, and 2003 - 2004. The survey asks elementary school teachers about the time they devote to teaching core academic subjects.

SASS Methodology

In the mid 1980s, NCES integrated several surveys including the Private School Survey, the Public School Survey and the Teacher Demand and Shortage Survey, which had been conducted since the 1970s with separate principal and teacher surveys. The result of the changes in the 1980s was a new comprehensive survey system called the Schools and Staffing Survey (SASS). Prior to the first round of SASS in 1987 - 1988, NCES conducted a pretest of the content, followed by in-depth interviews in preparation for the first full-scale SASS. According to NCES (2008a) the sample design called for selecting schools with a probability proportional to the square root of the school's teacher

population size and, within each stratum, selecting a fixed number of teachers subject to constraints on the total number of teachers selected in a school. For the first administration of the instrument, letters were sent to sample schools who were asked to provide lists of their teachers for inclusion in the national teacher sample. In the spring of 1988 the first mailing of questionnaires to districts, principals and teachers took place. Six weeks after the initial mailing, a second questionnaire was sent to those who had not returned the first questionnaire. Telephone follow-ups to non-respondents began a month later and, whenever possible, surveys were completed by phone (NCES, 2008a). During this first administration of the SASS, 56,242 public school teachers completed surveys with a response rate of 86.4%. Table 7 provides data on the number of public schools and BIA schools participating in the first five administrations of the SASS. For the 1990-

Table 7: SASS data by year, public or BIA school, number of teachers and response rate. (adapted from six years of data reports available from NCES)

Public School Teachers			BIA School Teachers		
Year Given	Number	Response Rate	Year Given	Number	Response Rate
1987-1988	56,242	86.40%	1987-1988	N/A	N/A
1990-1991	46,705	90.30%	1990-1991	101	97.70%
1993-1994	53,003	88.20%	1993-1994	2,690	86.50%
1999-2000	56,354	83.10%	1999-2000	506	87.40%
2003-2004	52,478	84.80%	2003-2004	710	92.00%

1991 SASS and subsequent iterations, the sample was modified to obtain estimates for Bureau of Indian Affairs (BIA) schools and American Indian schools (those with 25 percent or more Indian students). In the Teacher Survey, separate domains were included for Asian and Pacific Islander teachers and for American Indian, Aleut and Eskimo teachers (NAEP 2008a). The 1999-2000 version of the SASS included public charter schools as a sampling subgroup while, for the 2003-2004 version of the SASS, these

schools were not segregated as a specific type of public school, and the focus returned to public, private, and BIA schools.

SASS Results

Perie, Baker, and Bobbitt (1997) studied the data available from the first three administrations of the SASS instrument and found that first through fourth grade teachers spent an average of 2.5 hours per week teaching science in the 1987 -1988 school year. They also found that for the 1990 - 1991 school year, the time for science had decreased slightly to 2.2 hours per week. The time rebounded again during the 1993 - 1994 administration to an average of 2.8 hours per week. When looking at these three academic years as a group, the changes between years seems negligible with a variation of about 20 minutes between the three weekly averages. A difference of 13 hours per year results from this 20 minute per week increase.

The SASS and NAEP data paint a broad picture of science teaching in the United States, with the number of hours devoted to teaching science in the fourth grade found in both studies to be in the range of 83 hours a year (2.2 hours per week) for the NAEP to 97.5 hours a year (2.5 hours per week) according to SASS data. This data indicates a predictable range of science teaching time at the national level when these instruments are used. However, there are several other instruments, including the Surveys of Enacted Curriculum and the National Survey of Science and Mathematics Education, discussed in the following paragraphs that add additional detail to the data provided by the SASS and NAEP.

Surveys of Enacted Curriculum (SEC)

According to Blank (2004) and Blank, Porter, and Smithson (2001), the SEC is comprised of a practical, reliable set of data collection tools developed by the Wisconsin Center for Educational Research (WCER) in conjunction with the Council of Chief State School Officers (CCSSO). These are being used with teachers of mathematics, science and English language arts in grades K - 12 to collect and report data on current instructional practices and the content being taught. Blank (2004) goes on to say that, in addition to providing background data like time spent teaching a subject, the resulting data provide an objective method for educators to analyze the degree of alignment between current instruction and state standards and assessments. One other aspect of this instrument that is of particular interest to my research, and aligns with one of the research questions, is a section that addresses influences on teaching, which will be discussed in detail in a later section of this chapter. Currently the SEC is being used in 23 states and three large urban districts to assist teachers, administrators, and policymakers with planning for instructional improvement (CCSSO, 2008).

SEC Methodology

The Surveys of Enacted Curriculum in Mathematics and Science were developed 1998-2000 by a collaborative of state education specialists and researchers at CCSSO, with the survey instruments and data reporting designs based on research conducted by WCER (CCSSO, 2008). WCER developed and field-tested a two-dimensional framework for collecting data on instructional practices and content taught in classrooms and analyzing alignment with standards. The major concepts underlying the design are drawn

from state and national content standards, state initiatives in science and mathematics education, and prior research studies on classroom instructional practices and curriculum content (CCSSO, 2008). One of the unique aspects of the SEC is that can be reported in a graphic approach that displays instructional data and content maps related to specific subject content.

Once the instruments were developed, a large field study was conducted with 600 teachers in schools in 11 states (Blank, 2004). Information from this pilot was used to improve both the survey instruments and the data reporting methods and formats. The instrument was further tested and refined for use in measuring and design of professional development when a team from CCSSO conducted an experimental design study with 40 urban middle schools involved in a professional development program designed for improving instruction in math and science (Blank, 2004). Based on the middle school study by Blank (2004), and on a report of the initial pilot study by Blank, Porter, and Smithson (2001), the SEC has a high level of reliability in test-retest statistical analyses and inter-rater reliability regarding the scoring of content alignment with standards. SEC teacher survey responses have also been analyzed in comparison to observational studies, as well as validated through interviews, focus groups, and student surveys, providing a high level of reliability (.604 to .876 depending on the item). One item of particular interest to my research is average hours teaching science during a typical week. This data was reported as an average, with 44.9% of elementary teachers completing the 1999 SEC (Blank, Porter, and Smithson, 2001) reporting that they teach less than four hours of science each week. The authors commented that there was a high degree of variation

from state to state, from school to school, and within schools with weekly science teaching time ranging from zero hours per week in one third grade classroom to five hours per week in another third grade classroom in the same Montana school (Smithson, 2007). SEC data specific to Montana (Smithson, 2007) for 62 grades 2 – 6 teachers report an average of just under three hours of science teaching per week. However when this data is disaggregated by grade level (See Table 8), one can see that lower grades spend less time teaching science each week,

Table 8: Montana SEC teaching time reported by grade.

Grade (n)	Average Weekly Hours	Average Yearly Hours
2 (6)	1.67	66.8
3 (11)	2.09	83.6
4 (8)	2.63	105.2
5 (25)	3.68	147.2
6 (12)	4.58	183.2
n = 62	2.93	117

and visa versa. This degree of variation makes it difficult to determine a generic mean science teaching time for elementary teachers using the SEC and suggests that while this instrument provides valuable data regarding the research questions addressed by this dissertation, more sources such as the National Survey of Science and Mathematics Education are needed for more accurate interpretation of teaching time.

National Survey of Science and Mathematics Education

This instrument was designed by Horizon Research Inc (HRI) to provide up-to-date information and to identify trends in the areas of teacher background and experience,

curriculum and instruction, the availability and use of instructional resources, and allocation of mathematics and science teaching time.

National Survey of Science and Mathematics Education Methodology

According to Weiss, Banilower, McMahon, and Smith (2001), the sample design for the instrument was based on a national probability sample of 1,800 schools and 9,000 teachers K–12 in the 50 states and the District of Columbia. They say that the sample design allowed national estimates of science and mathematics instructional techniques, including time devoted to science instruction, as well as other data related to teaching mathematics and science in the United States. Fulp (2002) in her focus on elementary science notes that every eligible school and teacher in the target population had a known, positive probability of being drawn into the sample, which Weiss, et al. (2001) comment involved clustering and stratification of elementary and secondary schools. The study design included obtaining in-depth information from each teacher about curriculum and instruction. My interest is in elementary teachers who taught in self-contained classrooms, and therefore are responsible for teaching all academic subjects to a single group of students.

Since a key purpose of the survey was to identify trends in science and mathematics education, the process of developing survey instruments began with questionnaires that had been used in the earlier national surveys in 1977, 1985–86, and 1993. According to Weiss, et al. (2001), experienced researchers in science and mathematics education reviewed these earlier questionnaires and made recommendations about retaining or deleting particular items and designed some additional items. Once the

instruments were in draft form, they were sent to a number of professional organizations for review and comment. Then they were field tested and revised again to help ensure that individual items were clear and that the survey as a whole would provide the necessary information regarding teachers and teaching practice.

Survey mailings to teachers began in the spring of 2000 and researchers used phone calls, additional mailings of survey materials, and cash incentives to encourage non-respondents to complete the questionnaires. This effort resulted in a teacher response rate of 74% and produced a total of 5,728 complete coded and weighted surveys from science and mathematics teachers in schools across the United States (Weiss, et al., 2001; Fulp 2002).

National Survey of Science and Mathematic Education Results

There are several versions of this survey, but my interest is in the elementary, grades K - 5, instrument. Based on the responses of 655 elementary teachers (Fulp, 2002) found that teachers spend an average of 25 minutes each day or 2.1 hours a week teaching science. This amount of science teaching time is somewhat lower, 25 minutes a week for the SASS and 7 minutes per week for the NAEP, but is within the range suggested by the SEC of less than four hours per week.

Summary Teaching Time in the United States

There are a variety of sources of information related to teaching time in the United States. These range from information included as background in the TIMSS

assessments to studies by the United Nations and the International Bureau of Education (IBE) that compare numerous parameters for education in the United States with other nations. On a national level, NAEP, SEC, SASS and research by HRI have provided data that paints a broad picture of science teaching practice in the United States. Not all the data is given in terms that are easy to digest. Some data, for example the work of Benavot and Amadio (2004), does not specify individual countries, and other sources like the SEC look at the data as a whole, generally reporting averages for all schools in a particular study, even though the data is collected at a much more specific level. For example, the SEC reports 44.9% of elementary teachers in 11 states teach less than 4 hours of science each week while the actual instrument disaggregates reported range into five possible responses from 0 hours to 4 hours. Raw data for the individual states, schools, grades, and teachers in a study are not typically reported except within the states of districts involved (Smithson, 2007). SEC data specific to Montana (Smithson, 2007) for 62 grades 2 – 6 teachers report an average of just under three hours of science teaching per week.

Table 9 compares the data that specifically looks at science teaching time in the

Table 9: Comparison of science teaching time in United States by instrument and year.

Instrument	Year	Average Hours	Grade(s)
NCES[1]	1997	104	4
HRI	2002	113	K-5
TIMSS	2003, 2007	95.2, 100.4	4
SASS	2003-04	97.5	K-8
NAEP[2]	2005	110.4	4

[1]Note: NCES and NAEP average hours are estimates calculated by converting percentages to actual times given in reported data.

United States obtained through studies using the TIMSS, SASS, HRI, and other studies. It is interesting to note that while the SASS and HRI instruments report the data for a grade range rather than individual grade levels as the other instruments, the difference between the instruments amounts to about 45 minutes a week, roughly 30 hours during a typical 40-week school year. It is important to note that the Montana SEC data (Table 8 above) suggests that science teaching in the fourth comprises 105.2 hours during the school year. This amount of science teaching time falls between the pre No Child Left Behind (NCLB) NCES report and the post (NCLB) NAEP report and suggests that science teaching time in Montana has been stable over the past decade. The following section of this chapter will address some of the factors that may influence the stability and changes in the teaching of science, specifically high stakes testing and national standards.

Time and Learning in a National Context

High stakes testing and national standards are not new factors that can effect teaching time. Before the current legislative emphasis on testing academic content and skills, The National Education Commission on Time and Learning (1994), in their report Prisoners of Time, concluded that higher standards will translate into more school time, more time for students and teachers to devote to mastery of the core academic subjects of English, mathematics, and science. For subjects such as art, geography, physical education, and foreign languages, the need to focus on the core academic subjects will

mean less time. Instructional time once devoted to non-core subjects will be reallocated to boost assessment of progress scores in the core subjects. This situation is similar to what Hargrove, Jones, Jones, Chapman, and Davis (2000) predicted in their pre No Child Left Behind (NCLB) study about the effects of high-stakes testing on the curriculum. They commented that one of the greatest concerns with high-stakes testing is the enormous amount of time that will be spent on reading, writing, and mathematics at the cost of instruction in all other subject areas including science. They also observed that elementary schools focused on meeting expectations of high-stakes testing typically spent seventy-five percent of their time teaching reading and mathematics, leaving inadequate instructional time for other subjects and potentially leaving gaps in student learning.

The narrow focus of these assessments has caused schools to prioritize reading and math instruction over instruction in science and other subject areas. Jones, Jones, Hardin, Chapman, Yarbrough, and Davis (1999) in their survey of 236 elementary teachers from 16 schools across North Carolina found that about two-thirds of the teachers indicated that they were spending more of their teaching time on reading and writing, while 56% reported spending more of their time focusing on mathematics. These teachers also reported that principals in their schools are free to focus additional instruction in certain subject areas as they wish with the result that science, social studies, and the arts are pushed aside and taught only if there is extra time left in the schedule (Jones, et al., 1999). The authors' comment that in one school the curriculum changed dramatically as the time to take the test grew closer, with the teachers going from involved hands-on science instruction several days a week, to using worksheets and the

textbook for group reading, and eventually to teaching no science at all. These pre-NCLB studies suggest that assessments with a narrow focus can cause schools to prioritize reading and math instruction over instruction of subject areas not emphasized by the assessments.

Since 2002, the NCLB Act, which was part of the most recent reauthorization of the Elementary and Secondary Education Act (ESEA), has been the major school reform agenda in America. NCLB was passed with the mandate that all students be at their appropriate grade level in mathematics and reading/English language arts by 2014. In order to measure the success of schools in attaining the goals of this mandate, required testing in reading and mathematics was put into place. To add further to the consequences of these tests, Mathis (2003) in his survey of the unintended consequences affecting states throughout the United States, including Montana, found that when schools are required to look at all subgroups, including Native American, English Language Learners, and students with disabilities, it is difficult to show progress without considerable financial investment, close to $2000 to $4000 per pupil per year in Montana. Mathis reports that if any one group is not making adequate academic progress, the entire school is considered "in need of improvement," and additional interventions that focus on reading and mathematics are added to the teaching day. In some cases teachers reported that their principals and superintendents are directing them to teach mathematics, reading, and writing in order to prepare students for testing, even if doing so meant teaching less science or social studies (Jones, et al., 1999). Mathis (2003), in his article discussing the costs and benefits of NCLB, comments that many teachers complain that NCLB is

unrealistic and has concluded that high-stakes testing is doing grave damage to education and to the lives of children. Smolleck (2007) in her article reflecting anecdotal data from years of classroom observations of elementary teachers as a researcher, agrees with Mathis, commenting that the teaching and learning of elementary school science has become almost nonexistent in some classroom in response to high stakes testing in other areas. She states that if she sees a science lesson being taught, it is usually taught at the very end of the day with whatever time may be left over before the final bell. If science is being taught, the time is consistently very minimal and typically does not reflect current reform efforts associated with science education (Smolleck, 2007). Typically what is seen are students engaged in reading exercises that require rote memorization of terms and definitions that are isolated from the real life experiences that have relevance and meaning to children.

Impacts on Teaching Time

For the past five years, the Center on Education Policy (CEP) has conducted a comprehensive study of NCLB. The 2007 report focused on the issue of changes in curriculum and instructional time. Specific questions about curriculum and instruction were included in the annual CEP survey of 349 school districts selected to represent districts nationally. District and school level interviews of teachers and administrators were also conducted in 13 school districts. The key findings from the study (McMurrer, 2007) included the following:

1. Increased time for subjects with mandated tests has occurred since 2002. About 62% of districts reported increased time in English language arts (reading) and/or mathematics in elementary schools, with a substantial increase in number of minutes reported. The average increase in minutes per week since 2001-2002 amounted to a 46% in reading and 37% in mathematics.

2. Reduced time was observed for other subjects. To accommodate this increased time for mathematics and reading/language arts, 44% of districts reported, at the elementary level, reducing time from one or more subject areas or activities such as social studies, science, art, music, physical education, lunch, and recess. The total decreases added up to 141 minutes per week across all subjects, on average, or 28 minutes per day. This decrease represents an average reduction of 31% in the total instructional time devoted to these subjects since 2001 - 2002.

3. Increases and decreases were more prevalent in districts with schools identified for improvement. Greater proportions of increases for reading and mathematics instruction were reported from districts with at least one school identified for NCLB improvement compared to districts without schools under improvement. Districts with at least one school in improvement also reported decreased time for social studies, science, art, and music compared to those without schools in improvement.

4. Greater emphasis on tested content and skills. Since 2001-2002, most districts have changed their reading and mathematics curricula to put greater emphasis on the content and skills covered on their state tests used to meet NCLB assessment requirements. In elementary reading, 84% of districts report curricular changes "somewhat" or to a "great extent" to put more emphasis on tested content. Similarly in mathematics, 81% of districts reported that they have changed their curriculum at the elementary school level to emphasize tested content and skills.

Dorph, et al. (2007), looking at surveys from 923 elementary teachers in nine counties in California, indicate similar impacts on science teaching time due to state testing mandated under NCLB. They found that 80% of grade K - 5 teachers who are responsible for teaching science in their classrooms reported that they spend 60 minutes or less per week on science, and 16% of the teachers spend no time at all on science. This study mirrored McMurrer's (2007) finding that teachers and administrators report a diminished amount of time spent on science since the enactment of NCLB. Districts with

schools in Program Improvement status because of poor performance in language arts and mathematics often report little to no time allocated for science (Dorph, et al., 2007).

Consequences that result from weak school or district performance on statewide tests required by NCLB legislation have resulted in the narrowing of the curriculum being taught and the loss of teaching time for non-tested subjects like social studies, art, music, or subjects like science that are now tested, but do not affect school funding or NCLB designation. This narrower focus of the curriculum and the limitations put on the time available to teach non-tested subjects means that teachers will further need to maximize the time they have in order to meet the needs of all students. Jones, et al. (1999) in their pre NCLB study, found that 80 % of the teachers in their study reported they spent more than 20% of their total teaching time preparing students for end-of-grade tests, and that this time was being taken from regular instruction in non-tested subjects for test preparation and seriously narrows the focus of the curriculum to just those concepts that are to be tested by the state. Reducing time for teaching and learning science is contrary to the recommendations of several organizations that call on teachers to provide more time for science in order to promote higher-order thinking and problem solving. The Virginia Department of Education (1992) suggests that increased academic learning results when students are given the time to be actively engaged and experiencing academic success in the ways that suit them best. Additionally the report of the National Education Commission on Time and Learning (1994) recommended teaching strategies such as providing more opportunities for hands-on learning, encouraging group work, and those techniques that free students from rigid time demands, and that do not narrowly

define success by improved test scores. The strategies being called for were further developed by the National Research Council (NRC) in 1996 when the National Science Education Standards (NSES) called for adequate classroom time for science and science teaching approaches that actively engage the students in "minds-on" experiences.

These studies, and the standards that pre-dated NCLB, called for the movement of the curriculum from a narrow focus on testing of just a few subjects to a curriculum that provided the time needed to teach all subjects effectively. This call for more time for science instruction is also supported by the need to assess science meaningfully. Science is now included in the NCLB mandated testing, and some state science assessments are designed to do more than measure those things that are easiest to measure (Mathis, 2003). The focus of the better state science assessments is on higher-order understanding of science concepts. Jones, et al. (1999) comment that standardized tests that typically emphasize discrete facts and skills because they are easy to measure will need to be redesigned with questions that require students to analyze and synthesize information at higher levels. These outcomes are typically associated with inquiry-based approaches that encourage students to develop a broad understanding of scientific concepts, which they ideally retain over time (Cavanagh, 2004). NCLB now requires districts to test students in science beginning in grade 4. Therefore, waiting until middle school/junior high school to offer adequate amounts of science instruction is too late. Adequate time for science must be available in the early elementary years.

The previous sections of this chapter looked at science teaching time globally and in the United States, and impacts on available time by high stakes testing and other

factors in the United States. While the NSES (1996) call for increased time for science, this may not meet with much success as long as national assessments continue to focus on English language arts and mathematics (McMurrer, 2007; Dorph, et al., 2007), and schools and districts are penalized for low test scores in these areas (Smolleck, 2007). While the time needed to teach science may not increase in the foreseeable future, there are some things that teachers can do to make the most of the time available. The next section of this chapter will look at how teachers are using the time they have available for science, and how that use aligns to visions of good science teaching found in the National Science Education Standards, other standards, policy, and research documents.

Visions of Good Science Teaching and How Teachers are Using Their Teaching Time

During the late 1980s through the 1990s there was a sustained effort to create an environment in schools that would promote the learning of science, mathematics, and technology. This effort resulted in the development of two national projects with the purpose of transforming schools. Project 2061, which was funded by the American Association for the Advancement of Science (AAAS) and the National Science Education Standards (NRC, 1996).

Project 2061

In the mid 1980's the American Association for the Advancement of Science (AAAS) began Project 2061 as a long-term initiative to advance literacy in science,

mathematics, and technology. The initial efforts of this project brought together over 140,000 scientists, educators, policymakers, and other stakeholders to determine what science every American should know and what science should be taught. Many papers, focused on improving science and science education have resulted from the work of this large and diverse group. Science for all Americans (AAAS, 1989) focused on adult science literacy and provided initial guidelines for the topics and concepts that should be taught in order for students to attain science literacy by adulthood. Building on this initial document, AAAS (1993) produced Benchmarks for Science Literacy that provided specific expectations for student learners and for their teachers in grades K-2, 3-5, 6-8, and 9-12 . One weakness of the benchmarks was that while they are very specific about what a student should know at the end of a specific grade, they do not make any recommendations for teachers on how they should meet the benchmark.

Donovan, Bransford, and Pellegrino (1999), in their overview of research on learners and learning, raised three key findings that were supported by solid research and strong implications for how teachers practice. They recommend that the following be taken into consideration in teaching practice to enhance student learning:

1. Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.

2. To develop competence in an area of inquiry, students must: (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.

3. A "metacognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their

> progress in achieving them (Donovan, et al., 1999, p. 12-13).

Recommendations like these from Donovan, et al. (1999), and further work by AAAS, resulted in the document Designs for Science Literacy (AAAS, 2001) that describes effective curriculum models designed to help teachers move their students toward meeting the benchmarks. It is interesting to note that this document recommends what knowledge and skills are to be learned, but not the specific topics that need to be studied to meet learning goals. One suggestion is that teachers, curriculum developers and other stakeholders eliminate topics that don't effectively help students achieve goals and narrow the curriculum in order to better use the limited time available for learning. In 2001 AAAS also produced the first volume of the Atlas of Science Literacy which was the first serious attempt to graphically represent learning progressions, the sequence and grade level where students should be taught science, mathematics, and technology concepts in order to master the benchmarks. Building further on these documents and others, Donovan and Bransford (2005) recommend that teachers of science require a great deal of responsiveness to their students' ideas and thinking while implementing instructional approaches that incorporate important lessons from research on learning. They give examples of several models of teaching, including guided inquiry and model based inquiry, that are intended to be illustrative ideas for instruction that teachers may find useful in their own teaching.

Following on the lead of the AAAS and the recommendations of the Charlottesville education summit of 1989 that called for the development of national content standards, the National Research Council (NRC) in conjunction with the AAAS,

the National Science Teachers Association (NSTA), and other science curriculum groups began working on National Science Education Standards (NRC, 1996).

National Science Education Standards (NSES)

The NSES, like the AAAS Benchmarks, include content recommendations for what all students should learn. In addition the NSES include standards for teaching, professional development, assessment, programs, and the science education system (NRC, 1996). While all the standards are important and the content standards focus on what is important for students to know, it is the teaching standards that are or primary interest. According to the NSES (NRC, 1996), teachers are central to education, but they must not be placed in the position of being solely responsible for reform. In order to succeed in reforming practice they will need to work within a collegial, organizational, and policy context that is supportive of good science teaching, and students must accept and share responsibility for their learning (NRC, 1996).

There are six standards for effective science teaching outlined in the NRC (1996) document. While all of these standards are important to the learning of students specific recommendations found within standards A, B, D and E (indicated by *italic* font) are of particular importance to my research because they focus on individual teaching practice related to meeting the needs of diverse learners, like those served by the teachers in this study.

Teaching Standard A:

> Teachers of science plan an inquiry-based science program for their students. In doing this, teachers

- Develop a framework of yearlong and short-term goals for students.
- *Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students.*
- Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners.
- Work together as colleagues within and across disciplines and grade levels.

Teaching Standard B:

Teachers of science guide and facilitate learning. In doing this, teachers

- Focus and support inquiries while interacting with students.
- Orchestrate discourse among students about scientific ideas.
- Challenge students to accept and share responsibility for their own learning.
- *Recognize and respond to student diversity and encourage all students to participate fully in science learning.*
- Encourage and model skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

Teaching Standard D:

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers

- *Structure the time available so that students are able to engage in extended investigations.*
- Create a setting for student work that is flexible and supportive of science inquiry.
- Ensure a safe working environment.
- Make the available science tools, materials, media, and technological resources accessible to students.
- Identify and use resources outside the school.
- Engage students in designing the learning environment.

Teaching Standard E:

Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning. In doing this, teachers

- *Display and demand respect for the diverse ideas, skills, and experiences of all students.*
- Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community.
- Nurture collaboration among students.
- Structure and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse.
- Model and emphasize the skills, attitudes, and values of scientific inquiry. (NRC, 1996)

These standards are very general in nature, for example Standards D and E call on teachers of science to recognize, respond to, and respect student diversity and encourage all students to participate fully in science learning by what they say and do, as well as by the flexibility with which they respond to student interests, ideas, strengths, and needs (NRC, 1996). Standard E further states that teachers demonstrate respect for the ideas, activities, and thinking of all students by adjusting an activity to reflect the cultural background of particular students (NRC, 1996). Adjusting teaching to reflect the cultural background of these students, in this case Native Americans, and to include practices that have been found to benefit the learning of these students is the next section of this chapter. Standard A does not provide specific guidelines or attempt to define how the teacher teaches inquiry, the type of inquiry they should use, or how often inquiry needs to be used in the classroom. What the standard does do is to recommend activities that should help the teacher present inquiry in their classroom. One thing that the standards don't do is to provide specific guidelines for the amount of time that should be devoted to teaching science. Standard D simply states that teachers structure the time available so that students are able to engage in extended investigations.

Standards and Recommendations for American Indian Students

In 1995 the American Indian Science and Engineering Society (AISES) produced a set of comprehensive guidelines and recommendations that focused on ensuring that the cultural, educational, and social needs of Native American students would be met in school and classroom settings. While all these recommendations are important, the ones most closely aligned with this research include recommendations that teachers use group based problem solving activities that are inquiry based and hands-on. AISES also recommended that teachers understand the culture of the tribe or tribes that the majority of their students were from if they were to be successful in their teaching, and that the lessons they select are relevant to the culture of the students. The 2002 Learn-Ed Nations inventory tool developed by Northwest Regional Educational Laboratory (NWREL), in the section on professional development for teachers of Native American students in this chapter, is consistent with AISES recommendations. The Learn-Ed Nations document calls for instruction to use cooperative, inquiry based science centered on real word problems that are culturally relevant to students. The Learned-Ed Nations report also calls for the development of higher order thinking skills in students, and that instruction should be aligned with national, state, and local or district standards. Developed from the AISES guidelines, the Learned-Ed Nations recommendations and other resources, West Virginia University (2005) produced "Strategies For Teaching Science To Native Americans." This guideline to teaching Native Americans is less in-depth than its parent documents. It was developed by looking at the strategies that have proven most effective in helping Native American students succeed on large-scale and classroom assessments,

rather than starting with the broader research on how Native American students learn. This resource, like the others cited previously in this section, stress the teachers' understanding of the students' culture as a key to student success.

Instructional Practices that have the Greatest Positive Effect for Native American Students

Learning Style

Cole (1996) suggests that all interaction between individuals and groups is cultural in nature and Pewewardy (2002), reflecting on his review of research on Native American learning, reminds teachers that there is no one correct or best way to learn. Therefore, in a culturally diverse classroom, traditional western teaching may oppress learners who come from other traditions or cultures. With recognition of this diversity, it becomes the job of the teacher and school to construct a culturally responsive environment. Curriculum and teaching strategies that can help the students create bridges between their cultures and the subject matter must be used. Embracing cultural differences and modifying teaching to reflect multiple learning styles can lead to academic achievement for all.

Swisher and Deyhle (1987), in their review of literature regarding American Indian/Alaskan Native learning styles and related teaching styles, define student understanding as having two major components, learning style and interaction style. According to these authors, learning style is said to be the way that students acquire knowledge, and interaction style is the way that students demonstrate the knowledge they have learned. Hilberg and Tharp (2000), in their review of the literature on learning

styles of American Indian/Alaska Native students and students of other cultural groups, suggest that no single "learning style" can be applied to any cultural group. Sharp (2003), in her own teaching and her work with teachers of diverse students, allows that while it is important to avoid over generalizing ideas related to learning styles, there is a tendency toward four general ways of knowing or generating knowledge for most Native American and Alaska Native students. While teachers must determine learning styles on a student-by-student basis, this culturally based "Native American learning style" gives teachers a reference point. The "Native American" learning style discussed in the research of Pewewardy (2002), Sparks (2000), Hilberg and Tharp (2002), Demmert (2001), Demmert and Towner (2003), and Klump and McNeir (2005) reflect a holistic cognitive style for organization of information, a visual cognitive style for representation of information, a reflexive style for processing information, and a collaborative rather than competitive approach to solving problems and gathering information. The collaborative approach to solving problems and gathering information, which Swisher and Deyhle (1987) recognized as an interaction style, seems to benefit Native American students as well as non-Native students. According to Lowawaima (1995), both Native and non-Native groups use cooperation effectively to achieve group success, indicating that collaborative approaches may be an effective strategy for improving the achievement of all students.

Understanding Student Culture

Research by Haukoos and LeBeau (1992), Gordon, Stephens, and Sparrow (2005), Bice (2005), reviews of the literature on Native American learning by Pewewardy (2002), Apthorp, D'Amato, and Richardson (2003), and policy recommendations from

AISES (1995), NWREL (2002), and West Virginia University (2005) make a case that teachers need to develop cultural understanding of students, as well as provide culturally relevant classroom practice to best support student learning. Lukyx, Cuevas, Lambert and Lee (2005), based on their research of a year long professional development program designed to help elementary science teachers understand their own culture and how it relates to instruction, comment that teachers need to explore, understand and be aware of their own culture before they can meet the cultural needs of their students, and this is not as easy task. These researchers found that the teachers were able to apply the idea of culture to others, but not themselves. Based on pre and post surveys, they found the teachers showed no significant difference in knowledge of how to incorporate student culture in the classroom. While the teachers in this study were unable to apply their learning to their own practice, they could see the value in changing to meet the needs of students. Stodolsky and Grossman (2000) report that for teachers willing to adapt to student needs and cultural differences, student learning is positively impacted. Based upon their case study of eight experienced mathematics and English teachers and surveys from 700 additional teachers, these researchers found that the teachers who made changes for students needs and cultural differences held broad goals relating to their students as individuals (personal, social and academic). Such teachers also had access to new ideas, resources and instructional techniques that other teachers in the study were not able or willing to access. Based on these results, it appears that teachers who understand the individual needs of their students were more willing to adapt their classroom practice to meet students' needs. Pewewardy (2002) comments that this can provide a starting point

for understanding and accommodating students with the goal of developing meaningful pedagogical practices for Native American students.

Culturally Meaningful Pedagogical Practices

Swisher and Deyhle (1989), in their review of the literature on the differences and similarities in learning to learn and the demonstration of learning among several American Indian groups, suggest that there are many variables that affect optimal learning of students. Demmert (2004), in comments to Montana Indian Educators, noted that many of the variables identified by himself and other researchers are linked to a number of child, parent, and community characteristics, what he refers to as "risk factors" for lower achievement, that the teachers have little influence over. While teachers have no control over the number of siblings a student has or the economic circumstances of the student's family, they do have the ability to be culturally aware and address students' preferred ways of learning. Pewewardy and Hammer (2003), in their review of research that focused on holistic approaches to curriculum and instruction for Native American/Alaska Native students, comment that overcoming ethnocentric approaches to teaching isn't easy for a non-Native teacher. However, the benefits of creating a caring, trusting and inclusive classroom will include opportunities for the teacher to challenge students' intellectual abilities without alienating them from their own culture. Embracing the culture of the community is a theme that Cajete (1994) in his book, *Look to the Mountain: An Ecology of Indigenous Education* also advocates. Based on his personal synthesis of research on Native American learning, and his own experiences as an Indian educator, he recommends that academic success for Native students be centered on a

curriculum that blends traditional tribal values and cultural elements with appropriate content found in the typical western model of education. Culturally responsive teaching places other cultures alongside middle-class mainstream, macrocultures at the center of the classroom instruction paradigm (Pewewardy, 2002). This means that culturally responsive teachers develop curricula that are multicultural and welcome students who have ways of knowing that may differ from their own. This is aligned with Sparks (2000) who states that the teacher's primary goal for Native American students is to acclimate them to multiple societies and cultures without detriment to the student's own culture.

Nelson-Barber and Estrin (1995), in their monograph, look at studies targeting mathematics and science instruction for Native American learners, and connecting Native ways of knowing to the content. They comment that culturally responsive teaching requires teachers to convey subject matter within the context of familiar cultural experiences, local values, shared communicative norms, and interactive styles. Bowman (2003) calls this culturally relevant pedagogy, and Gay (2000) calls such approaches culturally responsive teaching. Bowman (2003) defines this approach as using the cultural knowledge, prior experiences, and performance styles of diverse students to make learning more appropriate and effective for them. Gordon, Stephans, and Sparrow (2005) comment that successful professional development projects for Alaska Natives have focused on blending a variety of strategies for teaching science process that make the learning a multidimensional experience that is real and culturally relevant for students and teachers (Gay, 2000). Gay suggests that culturally relevant teaching include

practices that respond to the students' need for a sense of belonging, honors their human dignity and cultural identity, and promotes their individual self-concepts. Bowman (2003) agrees with Gay and encourages teachers to use a holistic multidimensional approach that teaches the whole child and defines culturally relevant pedagogy as multi-sensory and congruent with Native ways of knowing. Bowman (2003) suggests that teachers follow the best practices of Native American Pedagogy outlined by Hankes (1998) in her study of Cognitively Guided Instruction (CGI) and Oneida/Native American pedagogy as is it applied to mathematics learning and effective content delivery for Oneida kindergartners. Hankes (1998) best practices include the teacher as facilitator, using sense-making instruction centered on real world experiences, problem based instruction centered on issues situated within the culture of the students, cooperative rather than competitive instruction, and instruction that is not time constrained.

These “best practices” align well with the National Science Education Standards for science teaching and Standards I, III, and V for Effective Pedagogy from the Center for Research on Education, Diversity and Excellence (CREDE) (Dalton 1998). CREDE has five standards that establish principles for best teaching practices that research has shown to be effective with both majority and minority students across subject, curricula, cultures and language groups (CREDE, 2009). The standards include collaboration between teacher and student, literacy development across all curriculum areas, connecting lessons to student’s lives, engaging students in challenging lessons, and emphasizing dialogue over lecture. Table 10 provides a matrix that compares

Table 10. Matrix of recommended culturally responsive instructional elements.

Recommended Elements	Policy and Standards	Literature Reviews	Research Studies	Books and Other works
Collaborative Learning	CREDE, AISES, Learn-ED, WVU, NWREL, NSES	Apthorp, D'Amato, and Richardson; Swisher and Deyhle; Pewewardy; Demmert; Bowman; Klump and McNeir	Lowamina, Gordon, Stephens and Sparrow; Houkoos and LeBeau	Sharp Cajete Gay
Pedagogy and Practice reflect standards	AAAS Learn-Ed, WVU, NWREL NSES,	Apthorp, D'Amato, and Richardson; Swisher and Deyhle; Pewewardy; Demmert; Bowman; Sparks	Gordon, Stephens and Sparrow; Stodolsky and Grossman	Sharp Cajete Gay
Integration of Subjects	CREDE, Learn-Ed, WVU, NWREL	Demmert; Klump and McNeir; Sparks		Gay
Lessons Aligned with Student Lives	NSES, CREDE, AISES, Learn-Ed, WVU, NWREL	Apthorp, D'Amato, and Richardson; Swisher and Deyhle; Pewewardy; Demmert; Bowman; Klump and McNeir	Gordon, Stephens and Sparrow; Hankes; Houkoos and LeBeau	Sharp Cajete Gay
Based on High Standards	CREDE, Learn-ED, NWREL	Apthorp, D'Amato, and Richardson		Cajete
Teacher Understands Culture of Students	NSES, AISES, Learn-ED, WVU, NWREL	Apthorp, D'Amato, and Richardson; Swisher and Deyhle; Pewewardy; Demmert; Bowman; Klump and McNeir	Gordon, Stephens and Sparrow; Hankes; Stodolsky and Grossman	Sharp Cajete Gay
Practice Sensitive to Local Culture	NSES CREDE, AISES, Learn-ED, WVU, NWREL	Apthorp, D'Amato, and Richardson; Swisher and Deyhle; Pewewardy; Demmert; Bowman; Klump and McNeir	Lukyx, Cuevas, Lambert and Lee; Hankes; Stodolsky and Grossman; Houkoos and LeBeau	Sharp Cajete Gay
Involvement of community Elders	WVU, NWREL	Pewewardy Klump and McNeir		Cajete

recommended elements of culturally responsive instruction.

In summary, the literature (Swisher and Deyhle, 1989; Demmert, 2001; Bowman, 2003; Apthorp, D'Amato, and Richardson 2003; Pewewardy , 2002; Klump and McNeir, 2005) indicate that the instructional practices that have the greatest potential for positive effect on the learning and engagement of Native American students should be collaborative endeavors that include learning through joint activity among teachers and students. These authors also recommend that teachers deliver content in a holistic fashion through culturally congruent curriculum materials. This approach emphases learning through observation and modeling rather than lecture and is often centered on real world experiences.

How Teachers Are Using Their Teaching Time

Weiss, Pasley, Smith, Banilower, and Heck (2003), in their report that details the findings from observations and interviews of 364 science and mathematics teachers in schools across the United States using the Horizon Classroom Observation Protocol (COP), found that 42% of the lessons being taught included significant and worthwhile content most of the time, and that 25% included significant and worthwhile content to a great extent. In a smaller study of middle school teachers working on or near the Crow and Northern Cheyenne Reservations, Woolbaugh (2004) found that for teachers working primarily with Native American students, 55% of the lessons being taught included significant and worthwhile content most of the time, and 22% included significant and worthwhile content to a great extent. While lessons generally include important content, the Horizon researchers comment that most lessons being taught are low in overall

quality. They say that for a lesson to be judged to be effective it must include meaningful experiences that engage students intellectually with science content. An effective lesson makes use of a variety of teaching and learning strategies to interest and engage students and to build on their previous knowledge, thus providing multiple learning pathways (Weiss, et. al., 2003). Such lessons are likely to facilitate learning and include opportunities for sense-making. These Horizon researchers found that one-fifth of lessons did not provide a means to intellectually engage students at a high level, and that 35% of lessons had failed to portray science as a dynamic body of knowledge. In addition to the lack of overall rigor in most of the lessons, these researchers found that there was too little concern for learning and even less respect for the students as individuals. Roughly 45% of lessons showed a climate of respect for students' ideas, questions, and contributions, and slightly less than 30% of lessons reflected instructional strategies and activities that reflect attention to issues of access, equity, and diversity for students (Weiss, et al., 2003). Woolbaugh (2004), whose study was conducted in close-knit reservation communities, saw somewhat different results with 69% of the lessons judged to show a climate of respect for students' ideas, questions, and contributions.

Analysis of data from the TIMSS 1999 video study in *Teaching Science in Five Countries* by Roth, et al. (2006) found that for eighth grade science classes in the United States, the data indicates that science lessons can be characterized by a variety of activities that may engage students in doing science work, with less focus on connecting these activities to the development of science concepts. The content of 44 % of lessons included weak or no conceptual links, while 27 % of the lessons did not develop science

content ideas at all, but instead focused almost completely on carrying out activities. The authors go on to say that the lessons are designed to keep students busy on a variety of activities, with a roughly equal emphasis give to three main forms: independent practical activities like hands-on exercises and laboratories; independent seatwork activities, such as reading, writing, small-group discussions; and whole-class discussions. About 23% of instruction was spent on motivating activities like games, puzzles, or role play. In some cases students had the opportunity to encounter some challenging content in the form of laws and theories, as well as some exposure to various forms of evidence such as visual representations and real-life examples, but only rarely were these sources of evidence linked to larger science ideas to create coherent, connected, in-depth treatment of science content in the lessons. The authors found that typically lessons were organized as discrete bits of factual information or problem-solving algorithms rather than as a set of connected ideas. For example, real-life issues were more often mentioned in U.S. lessons as interesting sidebars rather than being used as an integral part of developing science concepts.

Both the *Looking Inside the Classroom* study and *Teaching Science in Five Countrie*s report, based on the TIMSS 1999 Video Study, indicate that much of the teaching in the United States contains relevant science content. However, they show that much of the teaching is not meeting the vision of good science teaching found in the AAAS Benchmarks, the NSES, and other documents like the AISES guidelines. While the current state of teaching science seems to be lacking in vision, a study by Blank, Porter, and Smithson (2001) indicated that there are influences that have positive effect

on teaching practice.

Research on Influences on Teachers' Instructional Decisions

Teachers and their practices, while seemingly isolated from external and internal influences on their teaching once they close their classroom door, is the product of many sources of influence and these influences can work together or oppose each other in driving teachers' instructional decisions.

Lumpe, Haney, Czerniak (2000) and Stevens and Wenner (1996) comment that among the major influences on teaching practice are teachers' beliefs toward science and their understanding of science content (Trundle, Atwood, and Christopher, 2002). Bybee (1997) comments that some teachers have difficulty when teaching science because they feel inadequately prepared or not qualified to teach science content. Weiss (1997), in her review of the survey responses of 6000 teachers taking the Schools and Staffing Survey (SASS) in 1993, found that less than ten percent of elementary teachers felt very well qualified to teach the physical sciences. Abell (1990) and Abell and Roth (1992) attribute this to inadequate content preparation, which is especially common for elementary teachers. Tobin and Garnett (1988) agree that content knowledge is critical to teacher confidence in teaching science and comment that without adequate content knowledge, teachers are unable to focus their teaching on student thinking, making them less likely to provide meaningful feedback to students. This can render teachers unable to effectively present the content to students. Ramey-Gassert, Shroyer and Staver (1996) agree that content knowledge is a powerful influence on instructional decisions, pointing

out that teachers with strong content knowledge are confident in their teaching. However, these authors caution that, in addition to content knowledge, other intrinsic and extrinsic factors influence teaching practice.

Intrinsic Influences On Instructional Choices

Intrinsic influences are those that reside within the teacher. They are often related to Ford's (1992) concept of capability beliefs, which relate to how capable a teacher believes they are to teach a concept. This is comparable to Bandura's (1993) concept of teachers' beliefs in their personal efficacy to motivate and promote learning that affects the types of learning environments they create and the levels of academic progress their students achieve. According to Lumpe, Haney, and Czerniak (2000), in their interviews with 130 purposefully selected teachers, educators develop their beliefs about teaching from years spent in the classroom as both students and teachers. The purpose of their study was to develop and apply an assessment strategy designed to gauge teachers' beliefs about the potential influence of specific environmental factors on their science teaching behaviors. While I didn't use the same interview instruments used by these authors, the focus of their research was similar to mine. These authors studied teachers involved in professional development that included topics recommended by current science education reform, including inquiry and culturally responsive content and instruction. Lumpe, et al. (2000) found from their interviews that teachers' beliefs are not necessarily consistent with the literature about best practices in science teaching and are often resistant to change. Bybee (1993) comments that, because of this resistance to change, it is important for researchers and providers of professional development to

understand and address science teachers' beliefs about reform and student learning rather than ignore these beliefs. Lumpe, et al. recommend that this relationship between teachers' beliefs and instructional decisions be researched further and is an issue that this study will explore to a degree.

Teacher Beliefs

Pajares (1992) suggests that the beliefs teachers hold influence their perceptions and judgments, which in turn affect their behavior in the classroom. He says the concept of teacher belief does not lend itself easily to empirical investigation, and that researchers must first decide how to define belief before they can begin to understand how these beliefs affect teachers decision making. Pajares (1992, 2002) suggests that beliefs are personal truths about physical and social reality and a person's role in those realities, often unaffected by persuasion. Beliefs are teachers' perceptions of their ability to teach effectively and are the foundation of teaching behavior (Bandura, 1997). This belief is an internal condition that can be formed by chance, an intense experience, or a succession of events (Pajares, 2002), which, according to Green (1971), is not necessarily based on truth but is accepted as truth by the person who has the belief. This acceptance of truth gives the teacher the belief that they can either succeed or fail in any given teaching situation and, according to Stevens and Wenner (1996), this can influence a teachers' practice. If a teacher believes that they can perform a task successfully, they are generally more motivated to perform the task (Bandura, 1997). These beliefs, what Bandura (1997) calls self-efficacy beliefs, are constructed in the context of future events and tie to the teachers' internal perceptions of their capabilities to complete a task. Such

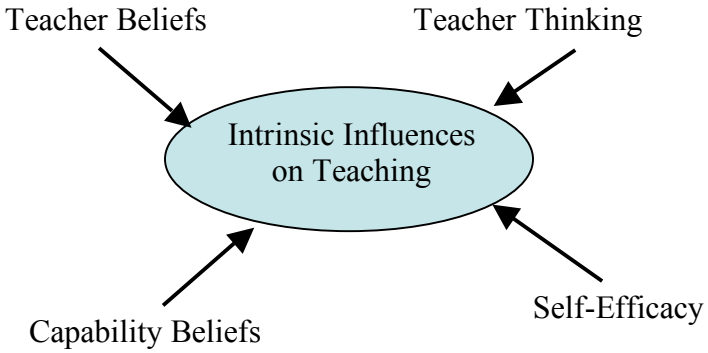
beliefs are often the best indicators of the decisions that they will make regarding their professional practice.

Woodbury and Gess-Newsome (2002) comment that teachers' beliefs, or what they term teacher thinking, is shaped by personal factors that affect practice. The authors add that professional experiences, including the nature and extent of preservice preparation and ongoing professional development, are additional personal factors that can affect teacher thinking and practice, and that teacher thinking is a complex internal relationship between an individual's knowledge and their beliefs about teaching, learning, and schools. Fullan and Hargreaves (1996) comment that these personal factors are the product of the teachers' life experiences, their value systems, their life and career stages, their confidence, attitudes, and gender. Ford (1992), in his discussion of personal agency beliefs comments that teacher thinking, what he terms anticipatory evaluations, provides information needed to decide whether to perform, inhibit, or change certain practices. Thompson (1984), in his study of teachers' mathematical beliefs and instructional practice, comments that teachers' decisions regarding curriculum and instruction are complex, and that teachers' experiences inside and outside the classroom drive these decisions. Soodak and Podell (1997) agree with Ford and Thompson and comment that decisions about practice center on a teachers' belief in their ability to bring about change in their students.

These internal beliefs, what Ford (1992) terms capability beliefs, are beliefs about one's own ability or skill to meet a particular goal. Based upon this concept and their

analysis of research on instructional strategies in science teaching, Tobin, Tippins, and

Figure 3: Intrinsic Influences (adapted from Ford, 1992 and Bandura 1997).



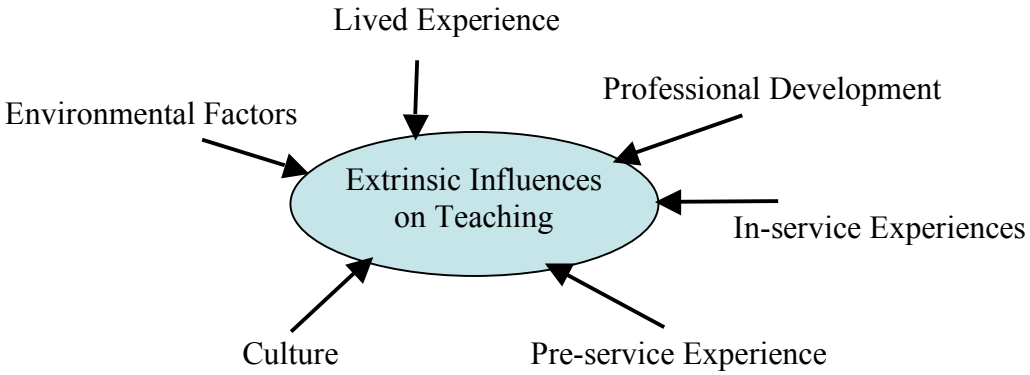
Gallard (1994) feel that these beliefs are a critical factor that determines what happens in classrooms. Bandura (1997) recognized that teachers do not operate in isolation and many factors (Figure 3, above) are involved in building a teacher's intrinsic beliefs system, including the environment in which they work. He argued that the total school environment has an effect on the teacher's beliefs about teaching and their ability as a teacher. This view is similar to Ford's (1992) claim that the environmental context plays a role in shaping science teachers' beliefs. Ford considers the context of environment to include the designed environment, human environment, and sociocultural environment and these extrinsic factors will be the focus of the following section.

Extrinsic Influences On Instructional Choice

Context beliefs (Ford, 1992) are teachers' beliefs about how supportive the environment is to the success of their instructional decisions. The relevant environmental factors may be within the school and may range from administrative style and collegiality

to physical space and equipment needs, or they may also be external to the school and range from family and community support to state and national policies or assessments. These environmental factors and other extrinsic influences (See Figure 4) are of particular interest to this study and will be addressed in the following section.

Figure 4: Extrinsic Influences (adapted from Ford 1992).



Environmental Factors

Environmental factors are both structural and can have an influence on teachers' instructional decisions cultural (Feiman-Nemser and Floden, 1986; Hargreaves, 1994; Sarason, 1996). Structural factors, what Aikenhead (1983) refers to as a system that has the potential to enhance or inhibit work, often include scheduling of subjects, students and teachers and the designed environment (Ford, 1992), or the physical space and layout of buildings (Hargreaves, 1994). Woodbury and Gess-Newsome (2002) add that the budget, the grade levels in the school, and whether or not the school is structured with departments, teams, or has content specialists also has an influence on teaching. Hargreaves (1994) adds that the curriculum, including mandated assessments, text

books, teaching materials and the technology available also influence what is taught. In addition to these structural factors, there are the more nebulous factors including the human and sociocultural environment, and demographic make-up of the community, the students, staff, and even the teachers themselves that can have an influence on teachers' instructional decision making (Ford, 1992).

In 2001, Weiss, et al., reporting on results of the 2000 National Survey of Science and Mathematics Education, noted several issues related to structural factors and science instruction in all schools. They found that school resources, including presence or lack of textbooks, science teaching materials, access to technology, and adequacy of funds and facilities, were important in responses to the survey. These authors reported that for respondents who teach in elementary schools the most serious structural factors were the need for materials related to individualizing instruction; limitations on time for planning, preparing and teaching science; limited opportunities to work collaboratively with other teachers; and the need for meaningful professional development and/or in-service education opportunities relating to science content and pedagogy. The findings of this study mirror the results of a similar report on the 1993 National Survey of Science and Mathematics Education (Weiss, 1994) showing that not much had changed in the seven years between these surveys, and Weiss, et al. (2001) suggest that these are factors that likely influence teachers' science teaching decisions. More recently Weiss, et al. (2003), in their *Looking Inside the Classroom* national study of K-12 mathematics and science education in the United States, found the influences on the content of science lessons most frequently cited by teachers are state or district mandated assessments, curriculum

standards, and the designated curriculum or textbook.

This shift to mandated assessments as a frequently cited influence on content of science lessons may be related to Grant's (2000) premise that testing drives much of what teachers do, and therefore curricular and instructional change will occur. Cimbricz (2002), in her review of literature regarding state mandated tests, found that these tests do matter and do influence what teachers say and do in their classrooms, and she suggests that the relationship between state testing and teachers' beliefs and practice is a complicated mix of ideas that include what teachers believe and perceive about the work of teaching, and how these ideas are expressed through their action in the classroom. Cimbricz reported that in some instances, as the pressure to improve scores intensified, teachers reported that they took the test more seriously for political reasons and not because they thought that the tests were actually improving their instruction. Brown (1992) found, based on open-ended interviews with 30 fifth and sixth-grade teachers and twelve principals from states with high-stakes state-mandated testing, that teachers altered the scope and sequence of their curriculum, eliminating concepts that were not covered on state tests. Brown also reports that the teachers he interviewed were reluctant to use innovative instructional strategies like cooperative learning and higher order thinking activities because they believed that more traditional instructional methods like lecture would better prepare students for state tests. Haney (2000) found a similar situation in his survey of 148 Texas teachers. This study looked at the effects that high-stakes state testing has had on minority and at-risk students. Teachers reported that due to the structure of the Texas test, social studies and science are being cut, and teachers

are limiting the focus of their teaching to only the curricula, content, and concepts covered on the state tests. Cimbricz (2002) suggests that what is tested is having a strong effect on what is emphasized in classrooms, and that the content measured on the tests occupies most of the instructional time for many teachers.

These studies are of interest to my research because they use teacher surveys to look at the effects of external influences, in this case mandated testing, on teaching practice. These studies indicate that teachers are tailoring their curriculum and instructional practice to conform to the content and concepts covered on the state tests. The studies also suggest that what is tested, primarily English language arts and mathematics, have become what is emphasized in teachers' classrooms, with these subjects occupying most of the instructional time available. Additionally, these studies show that mandated testing has influenced teaching practice by crowding science and other subjects out of the curriculum, producing a change in the cultural environment of schools.

Cultural factors involve patterns of behavior and interaction that Donahoe (1993), Fullan and Hargreaves (1996), and Fullan (1996) comment includes commonalities of experience, and shared sentiments and acceptable norms of practice that can enhance or reduce learning opportunities in the classroom. Woodbury and Gess-Newsome (2002) agree and add that faculty collegiality, frequency of collaboration, and interaction between students and teachers also influence teaching practice and instructional decisions. Found within these school-based influences are community institutions like Sun Dances and Pow Wows, the shared norms and sentiments, habits of mind, knowledge

(Feiman-Nemser and Floden, 1986) and cultural beliefs and Native language (Ford, 1992) that may influence teacher practice.

Research by Flores (2001), who looked primarily at preservice teachers and Woodbury and Gess-Newsome (2002), who were looking at the effects of four models of school reform on inservice teachers, indicates that both structural and cultural context factors have influence on teaching practices. In the following sections of this chapter, I will look at the research that links meaningful professional development and/or in-service education opportunities to both of these contexts. While professional development is not the focus of my research, the teachers participating in my study are working within the context of a professional development program that seeks to improve structural and cultural aspects of their teaching as called for by Weiss, et al. (2001). Of particular interest will be studies that were designed to provide science content and pedagogy specifically to meet the needs of teachers of Native American students, and have been shown to have the greatest impact on teaching practice.

Professional Development

Professional development experiences are another source of extrinsic influence on teachers' instructional decisions regarding content and pedagogy. Supovitz and Turner (2000) gathered survey data from 3464 science teachers representing 666 schools in 24 communities from across the United States participating in Local Systemic Change Initiatives. They found that teachers who participate in 80 or more hours of professional development reported using inquiry-based teaching practices significantly more

frequently ($P < 0.05$) than the average teacher. This study suggested that long-term (80 hours or more) participation in professional development activities focused on inquiry science had a significant influence on the pedagogical approach used by these teachers. Additionally Supovitz and Turner (2000) found that individual teacher characteristics revealed several differences in both practices and classroom culture created by the teachers. These researchers found that male teachers were more traditional in both their investigative practices and in the culture of their classroom than female teachers. However, this gender-based difference was statistically significant ($P< 0.05$) only for creating an investigative classroom culture. This research suggests that the female teachers in these professional development programs have a greater tendency to make changes to their practice that move the classroom culture toward a more investigative culture. This difference is important to my research since all the teachers in my sample are female, and research discussed earlier in this chapter suggests that Native American students learn science best in classrooms where the investigative process is cultivated. Another interesting finding of Supovitz and Turner's (2000) research that ties directly to my research is that minority teachers, who represented 23% of the their sample and 30% in my study, reported significantly ($P < 0.001$) more frequent use of inquiry-based classroom practices and more elements of investigative classroom culture than did their White counterparts. This P-value, based on teachers' survey data after participating in the professional development, suggests that the minority teachers significantly changed their practice while the white teachers did less so.

Choy, Chen and Bugarin (2006), in their report based on over 52,400 teacher

responses to the 1999-2000 Schools and Staffing Survey (SASS) and interviews, commented that 9 out of 10 teachers participated in some form of professional development during the past year. Most of these activities were in the form of workshops, conferences, or training sessions, and less than half of the teachers participated in more innovative types of professional development activities that were identified by numerous educational, research, and policy groups as being high quality (Choy, et al., 2006). Fulp (2002), in her study of 655 grade K - 5 teachers, reported that only 27 % participated in professional development that involved meeting with a local group of teachers to study/discuss science teaching issues on a regular basis. Professional development experiences are extrinsic influences, often led by individuals or institutions from areas beyond the communities where teachers' practice. The findings of the authors above indicate that such experiences were often not embedded in or adapted to teachers; local school setting and culture. Such experiences may or may not be designed to reflect local contexts, which in turn affects their acceptance by and influence on teachers' decisions.

Professional Development for Teachers of Native American Students

Professional development leaders need to remember that the experiences of the teacher prior to, during, and after the professional development, as well as the environment of the school and the culture of the students and the community, all influence how well the professional development experiences are transferred into changes in teaching practice and instructional decision making. Professional development that embraces both pedagogical knowledge and pedagogical content knowledge, and that

includes knowledge of the students and their community (Council of Chief State School Officers, 2002), is considered essential if there are to be changes in teachers' decisions regarding their teaching practice. The Council of Chief State School Officers recommends that in order for professional development for teachers of students from diverse cultures to positively influence pedagogical decisions they need to address a variety of instructional strategies. These strategies should include experiences that provide teachers with strategies to encourage student development of critical thinking and problem solving, as well as provide teachers with foundational knowledge of the cultural, ethnic and socio-economic characteristics of students. The Council of Chief State School Officers (2002) suggests that as teachers build their repertoire of pedagogical methods and cultural understanding they will be better prepared to make instructional decisions that will benefit the learning of their students.

Apthorp, D'Amato, and Richardson (2003), in their review of literature on effective practice for Native American students, found that professional development programs that include opportunities for peer collaboration and use culturally congruent curriculum materials and instruction are critical to the success of formal learning and improved student achievement. Gay (2000), in her book on culturally responsive teaching, comments that teachers who acknowledge the legitimacy of the cultural heritage of their students and who work to build bridges of meaningfulness between home and school experiences, and between academic abstractions and the students' everyday realities, create a classroom environment more conducive to learning.

Several other reviews of the literature on effective practice for Native American

students (Demmert, 2001, Demmert and Towner, 2003, Woolbaugh, 2004, and Klump and McNeir, 2005) found that teachers who participate in professional development that includes cultural knowledge, focus on students' prior experiences, and integration of Native ways of knowing, had positive effects on student achievement. Teachers who present curriculum in a fashion with an emphasis on learning through observation and modeling had a positive affect on student achievement, as did teachers who had learned to used cooperative group work (Gay, 2000 : Bowman, 2003). Gay (2000) adds that teachers well versed in culturally responsive teaching used instructional techniques and activities that embrace the learning styles of all students, providing a variety of learning opportunities that included visual, auditory, and tactile experiences and that tie the content and the learning together into a classroom experience that teaches the whole child. The following sections will look at research studies that focus on the building of cultural understanding for teachers of diverse learners, and building content understanding within the context of professional development. These studies are important to this research because the teachers in my study are participating in a professional development program designed to provide science content and pedagogy in a culturally responsive manner.

Cultural Understanding

In an effort to understand how teachers' knowledge of student culture affects teaching, Haukoos and LeBeau (1992) studied 154 elementary teachers participating in a two-week professional development institute designed to help participants recognize their current teaching behavior in relation to the diversity of their students. The authors found

that teachers who not only became more self aware about their own practice, but who also exhibited increased cultural awareness about their students, were able to reflect upon diverse sets of cultural beliefs and design alternative teaching strategies that integrated student culture and science into the classroom. Participants were then encouraged to reflect on and discuss their own beliefs related to desired changes in practice and were encouraged to attempt new methods of teaching diverse students. Experience with these alternative teaching strategies during the professional development helped to build teacher confidence and led to changes in teaching practice that reflected more cultural connections and more lessons that used inquiry-learning methods with their students. This pedagogical approach was new to many of the teachers in Haukoos and LeBeau's study, like those in my research study, and without the professional development these teachers would have been less likely to implement methods considered relevant to the experiences of Native students. I selected this study because it included members of a local Native American community as a major component of the professional development, and because the teachers' participation in this program influenced changes in instruction that otherwise might not have taken place.

Building the ability of teachers of diverse students to implement instruction more relevant to the cultures of their students is important. This form of professional development is recommended by Halim and Meerah (2002) and Pewewardy (2002) and agrees with Haukoos and LeBeau's (1992) recommendation that teachers have both well-developed pedagogical knowledge and content knowledge in order for them to grow their pedagogical content knowledge. The Council of Chief State School Officers (CCSSO)

Model Standards for Science Teaching (2002) suggest that for professional development to affect change in teaching it should include both pedagogical and pedagogical content knowledge tied directly to understanding the students and their community. The CCSSO document goes on to say that these programs should also address a variety of instructional strategies designed to give teachers the skills and confidence to modify their practice in ways that encourage the development of critical thinking and problem solving in their students. Some professional development programs have been designed to meet these recommendations and have been designed to help teachers build their repertoire of pedagogical methods while focusing on knowledge of the cultural, ethnic and socio-economic characteristics of students. Such programs have been shown through the research of Valencia and Killion (1988), Zwick and Miller (1996), and VanHanegan, Pruet and Bamberger (2004) to increase student achievement through changes in practice related to participation in these programs. For example, in a study on the impact of district level professional development, Valencia and Killion (1988) reported gains in learning by students whose teachers received professional development that included knowledge of students' cultures. The students whose teachers were not part of the treatment showed little or no gain in learning. While the focus of this study was not on teaching science, students' culture was a key component, and the finding from this study suggests that the teachers' awareness of student culture gave them the ability to modify their teaching to better address student learning needs. The results of the Valencia and Killion's (1988) study are in agreement with Demmert and Towner's (2003) conclusion from a review of relevant literature on the influence of culturally based education on

academic performance of Native American children. They found children who are taught with culturally relevant pedagogy may do better on standardized measures of achievement than children who receive instruction that is not presented in a culturally relevant manner. Mariage and Garmon (2003), in a study of rural students in Michigan, found similar results when they researched professional development focused on helping teachers build both their repertoire and ability to implement pedagogical strategies to address the cultural needs of their students. They found that professional development with these foci gave participating teachers the skills and support they needed to positively impact student learning when measured by increases in standardized test scores over the five years of the project.

Capitalizing on Haukoos and LeBeau's (1992) findings that science inquiry approaches build on Native culture and make learning more relevant for students, Zwick and Miller (1996) describe a professional development program where teachers from a small rural Montana district with 49% Native students came together to develop outdoor science inquiry activities. The teachers who participated in this project were encouraged to present these newly designed activities to their students. For many of these teachers this was the first time that they had engaged their students in this type of activity. After the implementation of the lessons the researchers compared the California Achievement Test (CAT 85) scores of treatment and non-treatment fourth grade classes with similar demographics. A t-test and ANOVA were used to compare the experimental class that participated in the culturally based inquiry model and the control class that utilized the normal textbook based program that existed prior to the introduction of the inquiry

activities. The statistical comparison of the experimental class to the control class showed that the experimental class had greater gains on the CAT 85 science sub test score than the students in the control class. When looking at Native students in comparison to non-Native students within the experimental group, no significant differences were measured, indicating that the activities that were culturally relevant to Native American students had no negative affect on non-Native students. The results of this study suggest that building the cultural understanding of teachers is one major component of successful and effective professional development. But teachers must also have a clear understanding of the nature of science and the content they teach before they have the confidence to implement changes in their instructional practice. The next section of this chapter will begin to look at professional development programs that have been successful in providing the content and understanding teachers need to meet the learning needs of diverse student populations.

Content Understanding

As teachers deepen their knowledge of science content and their understanding of the use of different pedagogical approaches they strengthen their belief that they can more successfully teach science which, Stevens and Wenner (1996) commented, can influence their practice. In her case study of a high school biology teacher participating in a professional development program focused on helping to develop inquiry skills, Crawford (2000) comments that for this teacher she observed a change from the teacher as a dispenser of facts to one who was comfortable as a facilitator of student learning though inquiry. Tyler (2003) in her work with middle school teachers of primarily

African American students agrees. She conducted a longitudinal study that looked at student test scores for eighth grade physical science classrooms in four urban Virginia schools. She found that as the teachers' knowledge of the content and their ability to use and implement inquiry increased, so did the number of students scoring proficient on the science and mathematics portion of the state summative assessment. Tyler's (2003) study, while not focused on the same diverse population as my research, provides a unique insight into working with students from poverty. In her study each of the four classrooms had greater than 90% African American and economically disadvantaged students. Two physical science teachers from one of the schools participated in a two-week intensive inquiry and content institute during the summer of 1998 with follow-up sessions each semester and during the summer of the following two years. Prior to the 1998 summer session, the test scores for students at the treatment school were similar to student scores at the three other schools, with 25% of students scoring proficient on the mathematics portion of the Virginia Standards of Learning (SOL) exam. The science subpart score for the treatment school was 46% of students proficient or above, which fell slightly below the average scores of the control schools. After the initial summer session, the scores for students of the teachers who participated in the professional development treatment climbed to 49% proficient or higher for mathematics and 65% for science, while the student scores at the control schools remained essentially unchanged. This pattern continued through 2002 with 62% of students proficient or above for mathematics and 70% for science. This compares to 32% proficient or above for mathematics and 63% for science for the control schools. The researchers concluded that teachers who

participated in this sustained, content-intensive inquiry institute had gained sufficient content knowledge and pedagogical skills to transfer their experiences into teaching practices that produced measurable gains in student achievement.

The measurable gains in student achievement seen in Tyler's study of teachers immersed in sustained content and pedagogical professional development are supported by research by Fishman, Marx, Best, and Tal (2003). They studied an inquiry professional development program for middle school science teachers tied to the Center for Learning in Urban Schools (LeTUS) program within the Detroit public schools. They measured student performance on written pretests and posttests to judge the effectiveness of the professional development program. The design of this professional development centered around the presumption that for inquiry-oriented teaching to be successful, and for teachers to implement inquiry strategies into their teaching, it is often necessary for teachers' subject matter knowledge to be deeper and broader than is needed for traditional recitation teaching (Fishman, et al., 2001). These researchers report that in order to accommodate students' needs and increase student learning, "students need opportunities to construct knowledge by solving real problems through asking and refining questions, designing and conducting investigations, gathering, analyzing, and interpreting information and data, drawing conclusions, and reporting findings" (Fishman, et al., 2003, p. 648). The authors refer to this process as project-based science and comment that teachers who experience this same type of learning during professional development would be more likely to integrate this form of learning into their classrooms, increasing student learning. The professional development provided for

teachers revolved around five units constructed around national, state and district standards with content that the researchers considered meaningful to the students and anchored in real-world problems. The researchers measured the success of the professional development from several sources including pretests and posttests of students designed to align with the LeTUS curriculum units, classroom observation, and teacher focus group interviews. Analysis of the pretests and posttests indicated that after the teachers participated in the professional development there was an increase in student learning as indicated by an increase in the number of correct student responses. In the first year of the study, the gain from pretest to posttest was noticeable but not significant, with increases in the number of students responding correctly ranging from 6% to 8% depending on the item being assessed. In the second year the gain between student pretest and posttest scores was significant ($F_{(3, 2922)}$=34.34, p<. 001) with gains in correct responses ranging from 13% to 31%. Classroom observations by the authors indicated that the teachers post participation practice included elements of project-based learning presented during professional development sessions, and focus group interviews suggested that the teachers were more "comfortable" using project based learning with their students than they were prior to their participation, and that their participation in the program gave them the ability to teach differently than they had before (Fishman, et al., 2003).

Collaborative Learning

In an earlier section of this chapter (Table 9), collaborative learning was

recognized as one of the recommended elements of culturally responsive curriculum and instructional practice. In the following section professional development that included collaboration and collaborative learning will be discussed. While the main focus of Zwick and Miller (1996), Tyler (2003), and Fishman, et al. (2003) research was on the impacts of teacher professional development in inquiry and project based learning on student learning, and not on the process used to develop the experimental curriculum. All three studies indicate that the teachers who participated in these programs worked cooperatively as part of the professional development experience and were encouraged to use this form of collaborative learning with their students when they returned to the classroom. Zwick and Miller even suggest that the collaboration of the team of teachers, administrators, community resource personnel, and college representatives was one of the strengths of the project because it allowed everyone on the team to get to the same level of understanding about the students and the science, or what VanHanegan, et al., (2004) refer to as the development of a common language of learning that caused the group to grow into a cohesive learning community.

VanHanegan, et al. (2004) in their 3-year study of six high-poverty minority schools wanted to see if collaboration, like that seen by Zwick and Miller could be a successful model for professional development and have a measurable impact on student achievement as the teachers in the project adapted and modified their teaching to include more opportunities for collaborative learning. In this study, VanHanegan, et al. looked specifically at student mathematics achievement using TIMSS and SAT-9 test scores for students of teachers from the four schools that participated in a structured professional

development program. This program included collaboration as a major component. At two schools no professional development took place. Research indicated that for teachers in the treatment schools a collaborative group formed during and following the professional development that focused on the common goal of mathematics achievement. This collaborative learning community provided teachers with the support structure they needed to attempt new teaching strategies. Results of assessments indicated that students whose teachers participated in the professional development experience and implemented the strategies introduced and refined through the learning community scored one-third to one full standard deviation better on TIMSS and SAT-9 tests than students in schools where teachers received no professional development. Also noteworthy from this study was that students in the schools whose teachers participated in the professional development program continued to show higher test scores for a period of two years post treatment, further indicating the value of collaboration as a component of professional development.

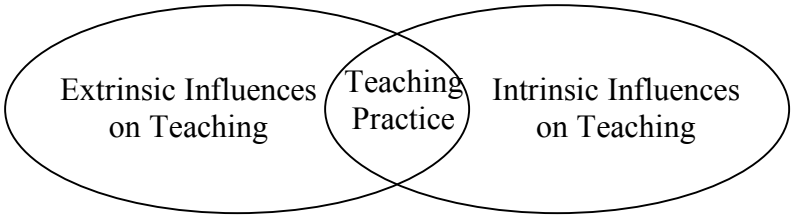
The models of professional development in the preceding sections have focused on design elements of professional development that research has show to have direct impact on teacher learning, teaching practice, and student achievement. While there are many different designs that encompass these elements, Locks-Horsley, Love, Stiles, Mundry, and Hewson, (2003). describe eighteen, it is essential that these elements focus on content, process, and context (National Staff Development Council, 2001) specific to the needs of the students, teachers, and school. Several recurring themes have emerged from the previous examples, the use of inquiry science as both content and process within

professional development and the recognition that cultural knowledge and focus on students' prior experiences, gave the teachers involved in these programs the skills and confidence they needed to make conscious changes in their practice that, in turn, had positive effects on student achievement. One of the questions addressed by my research centers on influences on teaching practice. These examples provide evidence that teaching practice is influenced by participation in professional development.

Conclusions

This chapter examined instructional time, specifically the time spent teaching science in grades k – 6 both globally and in the United States using various international, national, regional and state data sets ranging from TIMSS to the SEC and the SASS. These data showed that science teaching time is limited and is a resource that is affected by a variety of influences that range from high stakes testing to teachers' belief that they don't have the capability to teach the content sufficiently. The research literature reports how teachers are using their science teaching time and how that teaching reflected the vision of exemplary science teaching proposed by the NSES, AISES and other relevant guidelines. Influences on teachers' instructional decisions and how these decisions impact teaching were also examined (Figure 5). Teachers' belief in their ability to teach

Figure 5: Teaching Instructional Decisions Result from the Interaction of Intrinsic and Extrinsic Factors.



science has an impact on their practice, and providing teachers with experiences to build their content and pedagogical knowledge as well as their confidence in teaching has been a major focus of educational reform since 1994 when Goals 2000 called for exemplary professional development as a means to improve student achievement. In addition to this call for professional development programs that provide teachers with the necessary experiences and support to implement meaningful content and pedagogical approaches that encourage students to develop a broad understanding of scientific concepts, the NSES also called for increased teaching time for science. The standards also call for teachers to understand the needs of their students and the culture that they bring to the classroom in an effort to make science instruction an experience that will make the learning relevant, helping all children to succeed in science. With the NSES call for additional time and the impending inclusion of science as part of state mandated assessments there is the potential for an increase in teaching time for science. These changes in instruction will be driven by professional development that focuses on content knowledge, pedagogical content knowledge and cultural competency. This combination will strengthen teachers' belief that they are capable of teaching science content to all learners in their classrooms in culturally meaningful ways that will positively affect student learning.

CHAPTER THREE

METHODOLOGY

Introduction

The focus of this study was to gain an understanding of how grade K-6 teachers on the Crow and Northern Cheyenne American Indian Reservations in Montana use their science teaching time and to gain insight into the factors that influence their decisions regarding teaching time and practice.

The methodology to address the questions being asked in this study were guided by Patton's (2002) recommendation to embrace a "paradigm of choices," avoiding a narrow view of research and evaluation that may be unsuited to the research. Bogdan and Biklen (2007) agree, commenting that multiple realities and perspectives are essential to develop a rich description of practice. Denzin and Lincoln (2005) argue that the narrowly defined quantitative experimental designs are ill suited to the dynamic complexity of public educational research and recommend using multiple methodologies to capture the essence of teaching. They encourage current educational researchers to include the use of qualitative research methods to support quantitative findings. Johnson and Onwuegbuzie (2004) comment that both quantitative and qualitative methods are useful and important research approaches. However, they recommend the use of a "third paradigm" in educational research, where a mixed methods approach is used to draw on

the strengths and minimize the weaknesses of the single method paradigms. The questions being asked by this research focused on the amount of time devoted to teaching science, how that time was used, and what factors affect that time and the content they covered. To answer these questions, a mixed methods approach giving equal status to both qualitative and quantitative data was used. Qualitative methods were woven concurrently into the underlying fabric of data revealed by the quantitative instruments. Creswell, Plano Clark, Guttmann, and Hanson (2003) suggest the mixed method approach is advantageous because it allows the researcher to confirm, cross-validate, or corroborate data within a single study, providing a robust description of teacher classroom practice that expands rather than confines understanding (Creswell, 1994; Bogdan and Biklen, 2007) of teachers' perceptions of the factors that have the greatest influence on this practice.

This chapter contains brief descriptions of the Crow and Northern Cheyenne populations, the participating schools and teachers, and the various professional development programs for improving the science learning of Native American students that the participating teachers have been involved in. This chapter also outlines the design that was used for this study and a description of the sampling methods, data collection, research instruments and data analysis that were used.

Primary sources of data were collected through the use of survey instruments, interviews, teachers' reflective comments, and observations of participants' classrooms. Survey and interviews were utilized to understand teachers' perceptions of the influences

that govern their teaching and to quantify the time dedicated to the teaching of science. Observational data provided an additional opportunity to assess what is actually happening in the classrooms and will help to provide a more comprehensive look at the science teaching practice of participants.

The Context

The teachers who participated in this research work in schools on or near the Crow and Northern Cheyenne American Indian Reservations in southeastern Montana. The Crow Reservation is the largest reservation in Montana, encompassing 2.2 million acres of rolling upland plains, the Wolf, Bighorn and Pryor Mountains, and the bottomlands of the Bighorn River, Little Bighorn River and Pryor Creek. The reservation is home to 8,143 (71.7%) of the 11,357 enrolled Apsáalooke tribal members (Crow Tribe, 2008). In comparison the Northern Cheyenne Indian Reservation located directly east of the Crow Reservation is approximately 444,000 acres in size. Approximately 4,135 (44.9%) of the 9,194 enrolled tribal members residing on the reservation (Northern Cheyenne Nation, 2008). Both of these reservations are geographically isolated from larger urban areas. A major interstate passing through the Crow reservation provides it with better access to the closest urban area with a population of about 100,000. Access to urban communities by the Northern Cheyenne, is limited by two lane state highways roughly 50 miles from the closest interstate. Both reservations have levels of poverty that exceed other areas of the state. Thirty-three percent of the Crow reservation residents and about 40 % of Northern Cheyenne residents are classified as living in poverty (State of

Montana, 2008). The percentage of the population that contribute students to the schools in this study is similar, with the percentage of the population living below the poverty level almost twice the average for the state of Montana (US Census Bureau, 2000).

Teachers practicing in public, parochial, and Tribal schools participated in this study. The schools vary in size (10 to 130 students), percentage of American Indian Students (70 %to 100)%, accreditation processes, and curriculum. Tribal and private Catholic schools are not required to follow Montana Office of Public Instruction regulations and are exempt from NCLB testing requirements.

The Teachers

The participants in this study were grade K through 6 teachers who currently practice on or near the Crow or Northern Cheyenne American Indian Reservation. Active recruitment of potential participants occurred during the meetings of two earlier professional development programs. Prior to the Big Sky Science Partnership (BSSP), the most recent science and mathematics professional development programs available to the target teaching population were the Mathematics Inquiry Group (MIG) and the Science Inquiry Group (SIG) offered by the Center for Learning and Teaching in the West (CLTW). As with the BSSP, the primary foci of the MIG and SIG were to present standards based content and pedagogy, centered on integration of Native ways of knowing, to teachers who work primarily with Native American students. Additional recruitment efforts were directed toward the administration, primarily principals, of the schools on or near both reservations. Administrators were asked to recommend 3rd

through 8th grade teachers who they felt would remain in the school and/or district for the next several years, who had the greatest potential to bring new materials and teaching ideas back to the other teachers, and who were not first year teachers. Additional personal communication from the project director and project coordinator with prospective teachers during the spring and early summer 2007 resulted in the recruitment of a core of 17 elementary and middle school teachers for the current BSSP project.

Based on initial Surveys of Enacted Curriculum (SEC), the teachers in this core group reported a wide range of teaching experience. Eleven teachers reported having 11 to 20 years of experience, three teachers reporting less than 10 years of experience, and three reported 21 or more years of classroom experience. Of this group 14 teachers reported that they teach in self-contained classrooms, two reported that they were subject area specialists and one reported that she was a special education teacher.

The teachers from these schools differ in the amount and type of professional development opportunities they have participated in prior to joining BSSP. One source of professional development that is consistently present for all participating teachers is Montana State University's Center for Learning and Teaching in the West (CLTW) program. The CLTW has provided mathematics and science professional development projects consistently over the past six years. CLTW's programs typically follow a multiple year format that includes monthly one or two-day training sessions over the course of the school year. These projects have focused on pedagogical knowledge, science and mathematics content knowledge, and pedagogical content knowledge as it applies to teachers of Native American students. Another aspect of these programs was

to improve teacher's understanding of the national and Montana standards for science and mathematics so they could more readily develop lessons that reflected those standards.

The Big Sky Science Partnership (BSSP)

Like previous professional development projects, the current BSSP project, has monthly meetings where teachers are presented science content (Earth Science in year one) through a series of activities including concept mapping, inquiry laboratories, lecture, and field experiences. Stepping beyond previous models, BSSP included a foundational intensive two-week summer institute and facilitated online discussions throughout the school year. Participation in the first year of the BSSP project, by this self-selected group, has been very consistent with 100% attendance at the summer session, and monthly meetings ranging from 14 to 17 teachers. While the initial recruitment targeted grades were 3rd through 8th, several of the teachers who had completed the 80 hours of professional development during the summer had their teaching assignments changed and they continued to participate in BSSP. During the spring, two of the teachers in the initial group had both teaching assignment changes and personal situations that made it necessary to discontinue their participation. Of the remaining 15 teachers, 14 actively participated in the BSSP professional development sessions and became the population targeted by this study.

Selecting The Sample

All 14 BSSP participants were invited to voluntarily participate in the data

collection for this research. Ten of the active BSSP members (Table 11) participated in all aspects of the research and became the sample used in this study. In addition to the

Table 11. Matrix of sample teachers by grade, school type, and professional development prior to participation in BSSP.

Teacher/Grade(s)	School Type	PD Hours during the six years prior to BSSP	Provider
Tiffany - first grade	Public	36 – 60 hours	District, State, CLTW
Sarah - second grade	Public	36 – 60 hours	District, State, CLTW
Rebecca - third grade	Tribal	16 – 35 hours	District and CLTW
Angela - fourth grade	Public	7 - 15 hours	CLTW
Michelle - fourth grade	Catholic	61 + hours	District, State, CLTW
Melissa - fifth grade	Public	36 -60 hours	District, State, CLTW
Jessica - Reading and Mathematics Specialist	Public	7 – 15 hours	District and CLTW
Kimberly - K to grade 4 special education	Public	36 – 60 hours	District, State, CLTW
Christina - Elementary Technology Specialist	Public	36 – 60 hours	District, State, CLTW
Heather - third and fourth grade	Public	61 + hours	District, State, CLTW

face-to-face and online professional development participation, it was essential to this research that they complete eight weekly surveys, be observed several times by program staff, and complete a teaching portfolio. This subset of the original group includes teachers from seven of the eight schools in the region targeted by the BSSP. Table 11 (above) outlines the teaching assignments and professional development experience prior to participation in BSSP for the teachers in the sample. Each teacher is identified by a pseudonym for confidentiality and coding purposes. Table 12 provides similar data for the remaining teachers in the BSSP year one cohort. It is interesting to note that only two of the Native American teachers participating in the BSSP opted to participate in the research study. Five of the six Native American BSSP teachers were very active participants in the professional development portion of the BSSP and contributed greatly to the project.

Table 12. Matrix of non-sample teachers by grade, school type, and professional development prior to participation in BSSP.

Teacher/Grade(s)	School Type	PD Hours six years prior to BSSP	Provider
(1) Pine – Culture Teacher	Tribal	16 – 35 hours	District and CLTW
(1) Fir – fourth grade	Public	1 – 6 hours	CLTW
(1) Cedar – fifth grade	Public	16 – 35 hours	District and CLTW
(1) Spruce - 4th to 6th grade	Tribal	1 – 6 hours	CLTW
(1) Juniper - 6th to 8th grade	Public	36 – 60 hours	District and CLTW

Research Design

This study used a mixed-method design as described in Creswell (1994) in order to capture the perspectives of the participants in rich descriptive detail (Bogdan and Biklen,2007). The use of mixed methods of data collection enhanced the strength of this study and helped the researcher to better understand the factors that drive teaching practice for the participants, and according to Denzin and Lincoln (2005), capture as much of the reality as possible. The data collection instruments and analysis are outlined in Table 13.

Table 13: Matrix of research data collection and analysis.

Focus Questions	Data collection and analysis	Timeline
1. How much time are elementary teachers able to devote to teaching science and how is this time distributed?	1. Observation of practice and analysis using Horizon Classroom Observation Protocol.	Initial –May 2007
1a. How much time do teachers spend teaching science?	2. Initial Survey of Enacted Curriculum (SEC) section on use of class time.	Initial – June 2007
1a1. How is the time spent teaching science distributed through the time available for all instruction?	3. Interviews – perceptions of participants. (teacher based on SEC and Scoop Notebook as described by Borko and Stecher, (2006a).	Early Summer 2008, (June)
1a2. What patterns emerge in the distribution and use of time spent teaching science?	4. Weekly Teaching Survey (online and/or hard copy) reflecting on their science teaching.	Spring 2008, (March to May) weekly in WebCT.
	5. Scoop Notebook reflections on teaching of science.	Late Spring 2008, (April - June)
2. How do the teachers who teach science allocate their time for science instruction? 2a. Do teachers who teach science use pedagogical approaches recommended by the National Science Education Standards and related research literature?	1. Initial Survey of Enacted Curriculum (SEC) section on teacher opinions of teaching practice. Initial Cultural Inclusion Survey (CIS)	Initial – June 2007

Table 13: Matrix of research data collection and analysis (continued).

2b. Is the science taught related to local Tribal culture and contexts?	2. Observation of practice and analysis using COP.	Initial –May 2007
	3. Participant interviews using modified questions based on Luft and Roehrig, 2007 Teacher Belief Interview and modified COP.	Spring 2008. May-June).
	4. Weekly Teaching Survey (online and/or hard copy) reflecting on their science teaching.	Spring 2008, (March to May) weekly in WebCT.
3. What influences guide the teachers' decisions about how often and how they use their time to teach science?	1. Initial Survey of Enacted Curriculum (SEC) section on instructional influences. Initial Cultural Inclusion Survey (CIS)	Initial – June 2007
	2. Participant interviews using modified questions based on Luft and Roehrig, 2007 Teacher Belief Interview and modified COP.	Spring 2008. (April-June).
	3. Weekly Teaching Survey (online and/or hard copy) reflecting on their science teaching.	Spring 2008, (March to June) weekly in WebCT.
	4. Follow-up Survey of Enacted Curriculum (SEC) section on instructional influences.	Late Spring 2008, (June)

Methods of Data Collection and Analysis

Data collection and analysis in this study was a multi-step process utilizing both quantitative and qualitative methods. Data collection took place from June 2007 trhough June 2008. The data collection instruments and approaches will be described in the following section.

Surveys of Enacted Curriculum (SEC)

The Surveys of Enacted Curriculum (SEC) (Appendix A) originated from research and development projects of the Council of Chief State School Officers (CCSSO) and the Wisconsin Center for Education Research (WCER). The WCER collaborated with state education leaders in efforts to develop national content standards and assessments for science and mathematics (CCSSO, 2000). As part of this work, researchers from WCER tested the validity and usefulness of a survey approach to collecting reliable, comparable data on classroom curriculum and practices and from this work the SEC was developed (SSSSO, 2000). According to Blank, Porter, and Smithson (2001) the survey offers a practical research tool for collecting consistent data on science teaching practices and curriculum based on teacher reports on what is taught in classrooms.

This Likert-style survey provides data on the range of teaching practices and subject areas covered during the course of the school year. The SEC also provides information on the respondent's school, teaching assignments, academic preparation and professional development. One rationale for inclusion of SEC in this study was that specific sections within the instrument provided data to answer all three research questions posed. For purposes of this research, questions clustered on the topics of instructional activities in science (teaching time and teaching practice), instructional influences, professional development experiences, teacher opinions, and teacher characteristics were used. Research by Blank (2004) and Blank, Porter, and Smithson (2001) indicate that teachers self-reported responses to SEC questions have a moderate to

high degree of internal consistency reliability, with Crohnbach Alpha's from .604 to .876 (Smithson, personal communication, 2007) depending on item when analyzed in comparison to observational studies, as well as through interviews. Additionally the validity of the instrument was based on a review of the survey questions by content and curriculum specialists with WCER who found that the questions aligned with classroom curriculum and practices for teaching science (Blank, 2004).

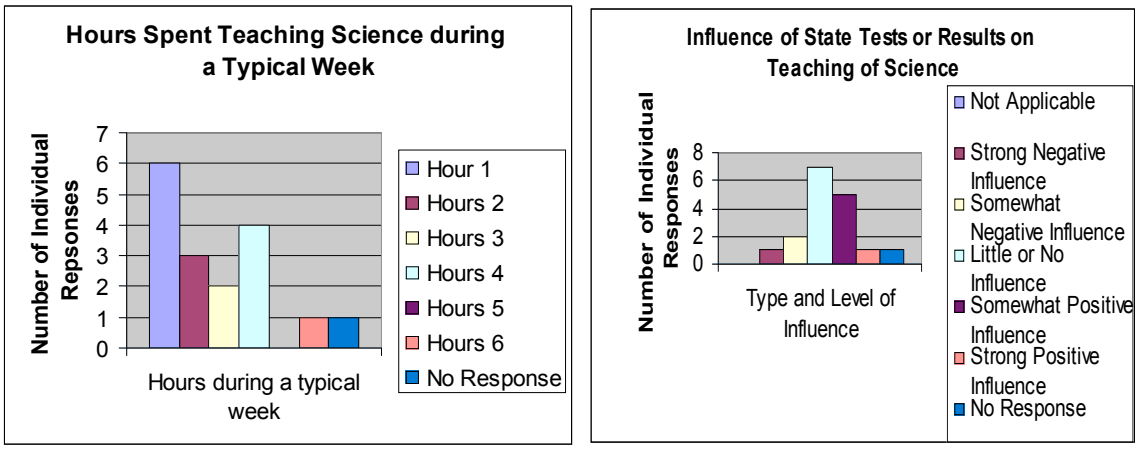
Cultural Inclusion Survey (CIS)

The Cultural Inclusion Survey (Appendix B) was designed by Sievert in 2006 as a way to gauge changes in teachers' cultural competency in teaching. The items were developed based on the elements of culturally competent teaching found in the research literature and other writing by scholars of American Indian education, and based on her own knowledge gleaned from years of working and teaching in Tribal colleges (Seivert personal communication, 2008). The CIS was edited from a larger survey used with a large number of treatment and non-treatment teachers in the Flathead Reservation schools who were part of a prior project that focused on improving cultural competency of teachers. Results from Sievert's 2006 study of cultural competency found the CIS to be highly reliable and results from her exploratory factor analysis identified clusters of similar topics interpreted as inclusion of historical and contemporary Tribal issues, integration of cultural content through language and the arts, the use of teaching and learning strategies that reflect Native ways of knowing, and the teachers' participation in curricular decision making and professional development experiences into the classroom.

Weekly Teaching Survey (WTS)

Another data collection instrument for this study was a weekly teaching practice, Likert-style, questionnaire designed by this researcher. The Weekly Teaching Survey (WTS) (Appendix C) was developed after preliminary quantitative analysis of raw data from participants initial SEC, CIS and Classroom Observation Protocol (COP). This instrument provided additional data regarding the themes of teaching practice, teaching time, cultural inclusion, and influences on teaching. Selection of the four themes found on this instrument was based on looking at descriptive statistics including means and distribution of responses for questions relevant to the research. In addition to means and range of responses, individual items from foundational instruments were viewed graphically (See Figure 6) to aid in framing the questions for the WTS and participant interviews.

Figure 6: Two examples of graphic data used to frame themes for WTS. Shown are graphs of initial SEC's for question representing hours teaching science during a typical week and influence of State Tests.



Once the 24 Likert-style questions on the WTS were selected, a pilot was undertaken with 12 elementary and middle school teaches not associated with the BSSP.

Teachers were asked to complete three weeks of the survey instruments and provide critical feedback to the author on the design of the survey and the potential time burden associated with completing the instrument on a weekly basis. Information regarding clarity of questions and format was elicited, along with the teachers' recommendations for inclusion or removal of questions. After completion of the pilot, the survey was refined based on results and recommendations form the pilot survey, and an open-ended reflective question was added to the final instrument. Questions 1-8 on the WTS (See Appendix C) focus on specific teaching practices and the time allocated to each of theses practices during the week. These questions were adapted from the SEC and use the same time intervals for teaching science as the SEC. Similar to the SEC, the WTS has expanded the questions regarding time allocated by the teachers for laboratory activities, investigations, or experiments as well as for student work in pairs or small groups outside of the laboratory setting. The WTS also looked at science teaching practices through several other lenses including a subset of questions related to cultural integration, connections to students prior knowledge and concepts and their everyday lives.

During the spring semester of 2008 the paper and electronic versions of the WTS were presented to BSSP teachers for review. Ten members of the BSSP agreed to participate in this aspect of the research, and nine of the ten submitted eight or more consecutive weeks of surveys. In addition to providing more "snapshots" of the distribution and use of science teaching time in BSSP instructors' classrooms than the lengthier SEC, the WTS also gathered information within a few days of the instruction.

The more frequent administration of the WTS was undertaken to provide more accurate representation of how the teachers allocated and used their science teaching time during each week rather than during the entire previous year. Patterns in the responses to the WTS items were identified using descriptive statistics and graphical display, and themes emerging from responses to the open-ended item were identified using the constant comparison method for qualitative data (Dye, Schatz, Michellenberg, and Coleman, 2000) that requires a purposeful approach to systematize the analysis process and to increase the traceability and verification of the analyses (Boeije, 2002). Additional follow-up phone interviews and written communications with pilot participants was conducted to further clarify comments and understand opinions regarding the instrument as a way to build validity to ensure that the instrument was measuring the constructs it was designed to assess.

Classroom Observation

Bogdan and Biklen, (2007) suggest a better understanding of participants behavior occurs when data is collected in the settings where the participants normally spends their time. Since this study deals with teaching practice, it is natural to collect data through classroom observation in an attempt to envision practice through the eyes of the subjects being studied (Angrosino, 2005). BSSP teachers were observed twice using the Horizon Classroom Observation Protocol (COP) (See Appendix D) during the 12 month study. Individual lesson observations were arranged prior to school visitations in order to reduce logistical interference (testing week, school awards assembly, etc). The COP is designed to monitor standards-based instruction in science and mathematics

classrooms and was used as one of the qualitative sources of data designed to address the research questions of this study. This COP instrument was initially developed to assess the effectiveness of science and mathematics professional development programs established by finding from the National Science Foundation funded Local Systemic Change initiative. This study used the 2005-2006 version of the COP which includes additional indicators from the American Association for the Advancement of Science (AAAS) Project 2061 Instructional Analysis Tool; the Arizona Collaborative for Excellence in the Preparation of Teachers Reformed Teaching Observation Protocol (RTOP); the Texas Collaborative for Excellence in Teacher Preparation Core Evaluation Classroom Observation Protocol (CETP) and others (HRI, 2004).

Qualified raters were used to perform COP observations in order to increase reliability of the results. Qualification as a rater was based on completion of an eight-hour intensive training provided by an experienced COP trainer. This full day training involved observing taped and live lessons and comparing ratings across observers, followed by group discussions of differences in ratings, and establishing group norms regarding how the observers would identify and assign quality ratings to particular classroom practices. The purpose of this process was to increase consensus among the observers regarding the attributes of instructional practice, along with improving inter rater reliability. The main benefit of using the COP, with its four categories of observations including design of the lesson, implementation of the lesson, science content of the lesson and classroom culture was to provide a window into the classroom practice of the subjects and to support results from the SEC and WTS data. Results of these

COP's helped the researcher gain a more accurate picture of how each teacher uses their science instruction time and further tease out the characteristic practice of the participating teachers.

Project staff who conducted COP observations were considered participant observers due to their involvement in the BSSP project. Thus, necessary precautions to minimize disruption were taken and considerations were made for potential distortion to data arising from interaction with participants. Observation of practice using the COP required minimal observer/participant interaction, thus lessening the effects of participant observation on the class being observed. This relatively structured protocol was also uses to reduce the biases in coding that can occur when observers know the participants well.

The validity of the Horizon COP instrument and associated interview protocols have been addressed in numerous studies of science and mathematics teachers as part of local systemic projects since 1977 (Horizon Research, 2004). Weiss, Pasley, Smith, Banilower, and Heck (2003) also used this instrument in their study of K-12 mathematics and science education in the United States. Additionally there is a training book and ten hours of video sessions designed to help minimize observer effects. During the video training sessions each observer rates eight lessons and then compares his or her scores to normative scores established by Horizon based on the data for 625 raters involved in other studies. The internal consistency reliabilities for item sets ranged from.92 to .97 (Horizon Research 2004). In this study, normative COP scores were established through facilitated discussion that occurred during the full day training of project staff as COP observers.

Interviews

The interviews (See Appendix E) were standardized open-ended questions (Patton, 2002) related to topics that were sequenced in advance in efforts to elicit more in depth responses (Fontana and Frey, 2005). The interview questions focused on eliciting descriptions from teachers about their science teaching time, science teaching practices, connections to historical and/or contemporary Tribal issues, and influences on teaching time and practice. Many of the questions were modified from Luft and Roehrig, (2007) Teacher Belief Interview and from the COP post observation interview. Bogdan and Biklen, (2007) consider an interview a purposeful conversation that is designed to extract information from one person by another person. Interviews data consisting of the participants' own words was used in conjunction with other methods of data collection to gather a range of descriptive data that would offer a better understanding of the time allocated for teaching and the type of science instruction used (Bogdan and Biklen, 2007). Fontana and Frey (2005) call this the basic method of gathering rich, in-depth experiential accounts of practice. The purpose of conducting interviews as part of this research was to provide an avenue for deeper understanding of areas identified for further study based on initial SEC survey data analysis and COP observational results.

Interviews, conducted with participants during the early summer 2008, added detail to overall understanding of the major themes of this research, how the teachers distribute and use science teaching time, and the factors that influence these decisions. The interview analysis was based on methods described by Patton (2002) and Fontana and Frey (2005). According to Fontana and Frey (2005) interviews are not a neutral tool

because each participant in the interview process incorporates both self and others (i.e., the researcher) into the building of meaning (Warren, 2002). Warren (2002) also suggests that pre-existing knowledge of the researcher may affect interpretation of the interview transcript, and that participants review interview transcripts to clarify their statements. In addition to verbatim transcripts, the researcher provided participants with interpretive summaries of interviews that they can review, clarify, and comment on. This helped to correct inaccurate interpretations, and can preserve the intended viewpoints of respondents in their everyday language, (Fontana and Frey 2005).

The level of credibility of findings from the interviews was established by following the recommendations of Bogdan and Biklen, (2007), Lincoln and Guba, (1985), and Patton, (2002). They explicitly suggest that it is important to not exploit the trust of the participants.

The Scoop Notebook

Data from the teachers Scoop Notebook, a tool developed by the Center for Evaluation, Standards, and Student Testing (CRESST) as an alternative approach for characterizing classroom practice (Borko, Stecher, and Kuffner, 2007), was also analyzed. The Scoop is designed to measure instructional practice by using a "scoop" of materials or a sample of instructional artifacts from classrooms for *ex situ* analysis (Borko and Stecher, 2006b). The concept of the "scoop" is based on an analogy to the approach scientists use when studying unfamiliar territory, they often "scoop a sample of

materials" to take to their laboratories for analysis. Teachers will keep Scoop Notebooks as part of their participation in the BSSP during the spring of 2008.

Borko and Stecher (2006b) have documented research that supports the reliability and validity of using artifacts from the Scoop to measure reform-oriented instructional practices. They remark that they focus on instructional artifacts because artifacts have the potential strength for representing what teachers actually do in classrooms, rather than what teachers believe they do (Borko and Stecher, 2006b). Results from a study of 39 middle school science teachers in two states indicate that Scoop Notebooks can be rated with reasonable levels of reliability (.70 to .93) on all but one dimension if three readers are used. Results from this research suggests that artifacts can be collected in a systematic manner and scored consistently-enough to be used to compare science teaching across classrooms (Borko and Stecher, 2006b). Criterion-related validity of the Scoop Notebooks as Measures of Reform-Oriented Instructional Practice is evidenced by a moderate to high degree ($r = 0.71$ to $r = 0.95$) of correspondence among ratings of reform-oriented classroom practice from a diverse group of data sources that were examined (Borko and Stecher, 2006b). In general, Scoop Notebooks yielded portrayals of practice that were similar to those based on observations. These similarities offer evidence that the notebook ratings are valid indicators of reform-oriented practice, as judged by direct observation.

In addition to collecting instructional artifacts, (Borko, Stecher, and Kuffner, 2007) teachers are asked to respond to reflective questions "as soon as possible" after completion of each lesson. These questions attempt to elicit information about the

teacher's classroom practice that might not be reflected in the selected artifacts. These "daily reflections" regarding the context of the lessons within the curriculum often include a description of student interactions during a lesson, and teachers' reactions to the lessons are sought to create a better portrayal of the teachers' day-to-day practice.

WebCT Posts

Additional reflective data was gleaned from electronic postings in the WebCT portion of the university earth science content course BSSP teachers are participating in. The inclusion of these postings provide more descriptive to support quantitative data and add depth and detail to make the interpretation of the quantitative data more meaningful and grounded evidence (Gilner and Morgan, 2000). These additional sources of descriptive data further the development of an understanding, which can be compared to a known landscape represented in research and act as a point of reference for the teaching practice of participants (Walker, 2002).

Creating Trustworthiness

Lincoln and Guba (1985) provide guidance regarding qualitative data collection methods. They refer to issues of trustworthiness and credibility. Trustworthiness is tied directly to data collection and analysis measures and is away of ensuring readers that findings are worth valuing. Lincoln and Guba (1985) suggest that trustworthiness is established when findings of the researcher reflect as closely as possibly the meanings described by the participants in the study. Credibility is dependent

on the process used to interpret the results and it involves ensuring that the data and the findings are aligned with the questions being asked. Bogdan and Biklen (2007) recommend that conducting research in a systematic and rigorous way improves the level of trustworthiness of the data and interpretations in a research study. My approach to data collection included: journaling practices to safeguard against distortions in data, and developing and maintaining a record keeping system that made it easier to retrieve and compare relevant evidence across multiple sources. Bogdan and Biklen (2007) suggest that as a researcher, it is essential to develop practices to safeguard against distortions in analysis of data by developing a procedure for data collection that is consistent from subject to subject and that can easily be verified by outside auditors, which can increase the probability of trustworthiness (Dereshiwsky, 2005). Trustworthiness of the results for this research was ensured by using multiple methods to collect data through a process Patton (2002) refers to as triangulation. This data collection procedure involves collecting data from multiple sources in an effort to verify patterns and themes that may exist between subjects. Bogdan and Biklen (2007) suggest that triangulation is an overused term and recommend that researchers who are using multiple sources of data state what the sources of data are and use those sources to verify common patterns of understanding across participants and avoid the imprecise and abstract concept of triangulation. I collected data from multiple measures including surveys, interviews, and observations to increase the level of trustworthiness of my results as well as reveal any patterns in teaching practice that may emerge. These recommendations limited the effect that my biases may have when collecting data and reporting results.

I was very concerned with distortions in the data due to my closeness to the subjects. This study involves working with teachers that I have built rapport and trust with over the past three years. Such a close relationship can be, according to Lincoln and Guba (1985), one of the greatest threats to trustworthiness. Bogdan and Biklen (2007) agree that closeness can threaten the trustworthiness of the research, and yet encourage researchers to value the trust relationship and to strive to maintain trust through respect for participants ideas and opinions. These authors recommend that as a researcher it is important to build trust and rapport with subjects, but caution against overdoing it. The recommendations for data collection discussed in this section were undertaken to limit effect of my biases when collecting and analyzing data, and reporting results.

Some educational research studies rely on only one source of data, which Bogdan and Biklen (2007) feel can limit the scope of the results so they recommend a variety of data sources, and Dereshiwsky (2005) recommends a combination of quantitative and qualitative methods to improve the credibility of research questions. Denzin and Lincoln (2005) agree and comment that the use of multiple methods reflects an attempt to secure a deeper understanding of the research being undertaken. In this project I followed the recommendations of these authors by using a variety of quantitative and qualitative data sources. In this study quantitative data was provided from SEC pre- and post-participation surveys, weekly teaching surveys (WTS), and the Horizon COP. Qualitative data was gleaned from participant interviews, teacher Scoop entries, and reflective responses from weekly teaching surveys and WebCT discussions. The use of a mixed methods approach provided an opportunity for readers of my research to step

into the classrooms of my subjects and see the details of their teaching practice, especially how they allocate and use their science teaching time. This level of depth enhances the reader's ability to envision how the subjects view their own teaching and the factors that influence the decisions that guide their teaching.

CHAPTER FOUR

ANALYSIS OF DATA

Introduction

In Chapter One of this study, several questions were posed that focused on elementary science teaching time, teaching practice during that time and the influences on both time and practice for teachers working primarily in schools with Native American populations. This chapter addresses each of the research questions individually, reporting the relevant data from each instrument. Once pertinent information has been extracted and described, I will discuss the themes that emerge and summarize the story these instruments tell collectively about the instruction of the teachers in my sample.

During the 2007-2008 school year I regularly attended monthly meetings of the Big Sky Science Partnership (BSSP) professional development program. My role in these meetings was one of a participant/observer. In the spring of 2008 I was given the opportunity to invite all BSSP participants to take part in my research as an additional and voluntary part of BSSP. Ten of the 14 teachers agreed to take on the additional task of completing eight Weekly Teaching Surveys (WTS) (see Appendix D), and to be interviewed (see Appendix E), following the completion of year one of the program. In addition to the WTS and the interviews, all the teachers in my sample completed the BSSP grant-required research elements including two Surveys of Enacted Curriculum (SEC) (see Appendix A), the Classroom Observation Protocol (COP) (see Appendix B),

the Cultural Inclusion Survey (CIS) (see Appendix C), and the Scoop Notebook. All of these were described in greater detail in Chapters Two and Three.

The following sections of the chapter will be organized by research questions and instrument, with a summary of results for each question that examines differences and commonalties within the data.

Teaching Time

The first question of importance to this study asked about the amount of time elementary teachers were able to devote to teaching science and how is this time distributed. Time is one educational resource that is often in short supply. While the length of the school day has been fairly static over the years, the time allotted for various subjects has undergone changes depending on political and societal needs at the local, state, and national levels. With pressure on teachers to maximize opportunities for teaching and learning and on schools to show, through improved test scores, that they are not leaving any child behind in English language arts and mathematics, many schools have changed the structure of their school day to extend the time allotted to learning opportunities (time) for some subjects. The issue that is of particular interest to this study is science and the time that teachers have for teaching science. The following section looks at the time available to teach science for the teachers in my sample through the lens of each instrument followed by a summary that teases out the commonalities and differences uncovered.

Surveys of Enacted Curriculum

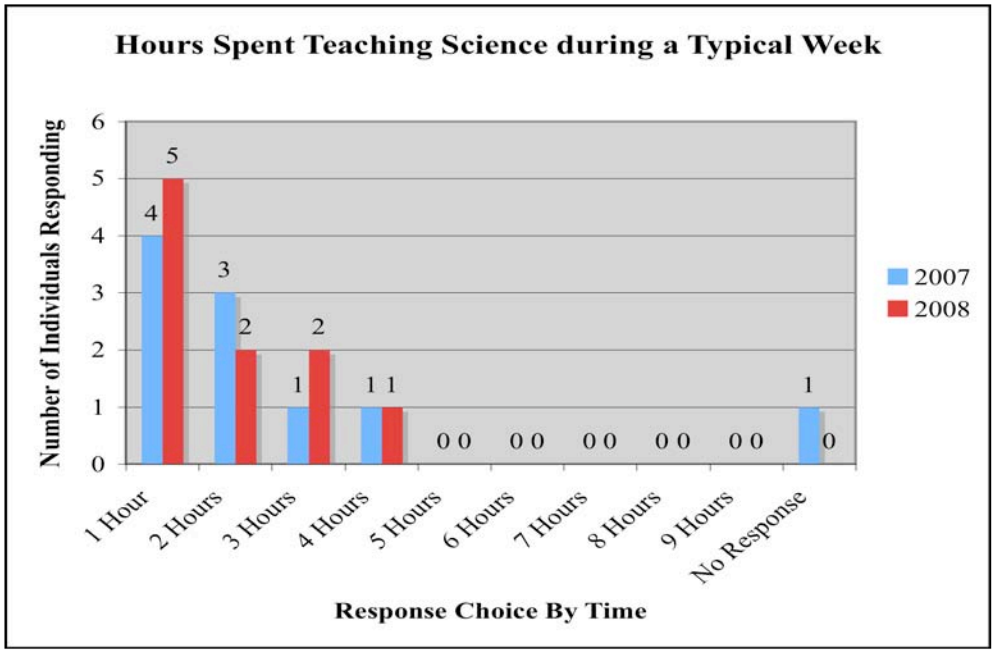
In early June 2007, prior to participation in year one of the BSSP, the ten teachers in this study completed the Survey of Enacted Curriculum (SEC) (see Appendix A). This instrument has 150 Likert style questions that range from demographic information to teacher opinions. The SEC was given a second time to the same group of teachers in early June 2008, shortly after completing their first year as members of the BSSP. The three SEC questions of particular interest to this research are those that focus on the amount of teaching time allocated to science during the school year.

> 8. *During a typical week*, approximately how many hours will the target class spend in Science instruction?
>
> 9. What is the average length of each class period for this targeted Science class?
>
> 10. How many weeks total will the target Science class/course meet for this school year?

Based on June 2007 responses teachers in my study taught science an average of 1.89 hours per week, with a standard deviation of .99, and a range of responses from one to four hours per week. Looking at the same three questions for the teachers in 2008 indicated that they taught science an average of 1.9 hours per week, with a standard deviation of 1.04, and a range of one to four hours per week. Figure 7 shows the frequency distribution for the June 2007 and June 2008 responses to question 8. It is interesting to note that in neither year did any of the teachers devote more than four hours per week to teaching science. The data suggests that there is almost no difference in

responses from 2007 to 2008 regarding teaching time. However, one teacher reported an increase from two to three hours and the teacher who did not respond in 2007 indicated that she teaches one hour a week of science in 2008. One other point of interest gleaned from both administrations of the SEC is the same teacher reported that she teaches science four hours each week for both school years. This data represents a small sample and variability between years may reflect changes in teaching assignment for several of the teachers rather than changes in science teaching time for the same teacher at the same grade level between the administrations.

Figure 7: Frequency distribution 2007 and 2008 responses for SEC question 8 (n = 10).



Responses regarding the average length of time for each class period (question 9) were more varied and are not adequately represented by an average. Figure 8 represents the frequency distribution for the June 2007 and June 2008 responses to question 9. Responses to question 9 for the 2008 SEC appear to differ only slightly from the 2007

responses, with the number of teachers reporting science periods of 41 to 50 minutes decreasing by one, and the number reporting that their average length of time for science varies increasing by one. However, when looking at the individual teacher responses to this question there is far greater variation than the frequency distributions would indicate.

Figure 8: Frequency distribution 2007 and 2008 responses for SEC question 9 (n = 10).

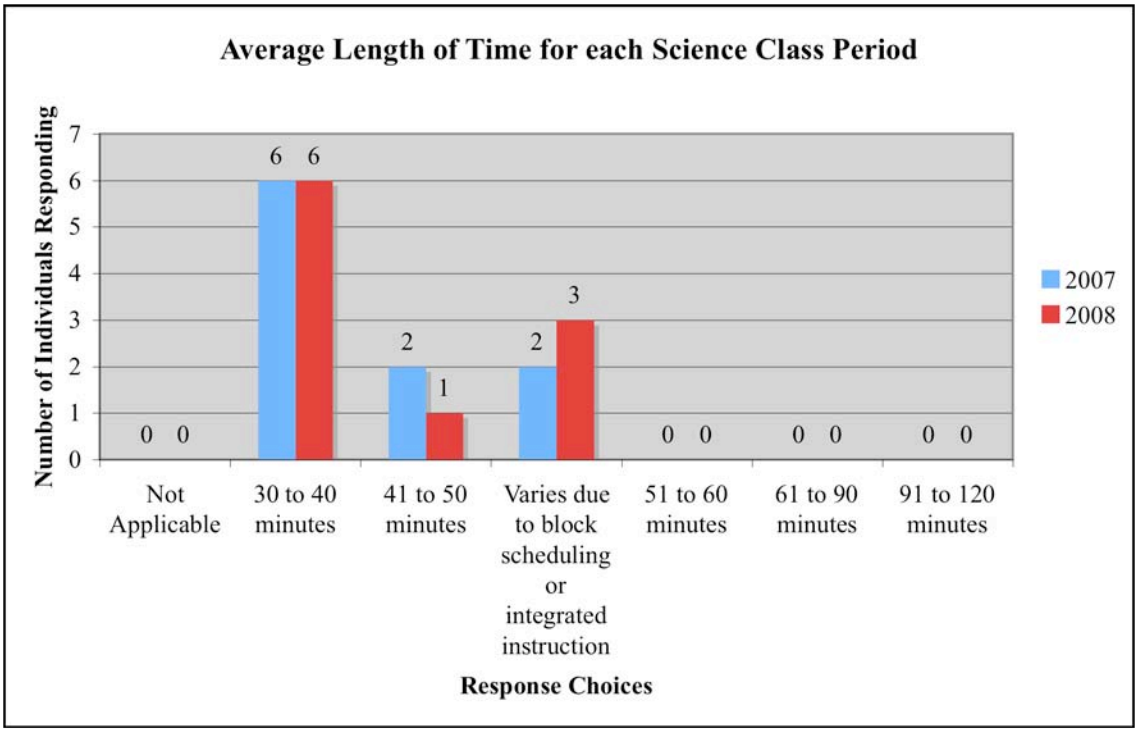


Table 14 provides a matrix that shows the changes in individual responses between

Table 14: Matrix showing individual response changes for question 9 between the 2007 and 2008 administration of the SEC.

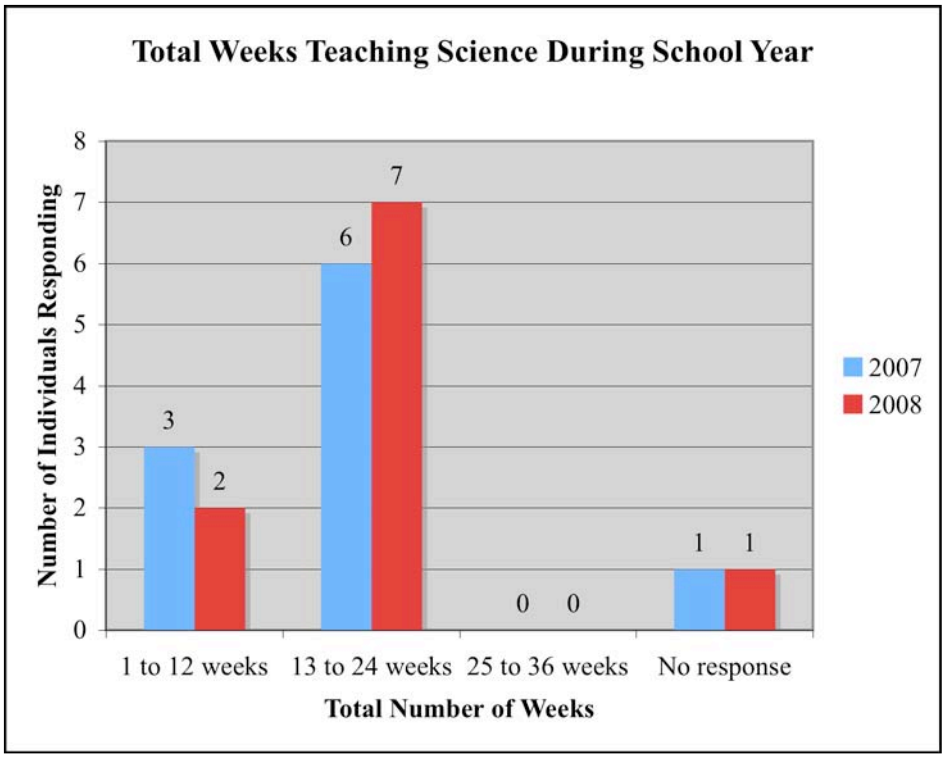
	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	3	1	2	1	1	1	1	3	2	1
2008	1	3	1	2	3	3	1	1	1	1

1 = 30 to 40 minutes, 2 = 41 to 50 minutes, 3 = varies due to scheduling etc.

administrations of the SEC. This matrix shows that only two of the teachers had no change in how they reported the amount of time for each science teaching period or lesson while eight in the sample reported changes. As with total reported time per week, variability between years may reflect changes in teaching assignment for several of the teachers in the study.

Responses to question 10 regarding the average number of weeks science is taught each year indicate that 60% of the teachers in the sample teach at least 13 weeks of science during 2007 and 70% during 2008 (see Figure 9). It is interesting to note

Figure 9: Frequency distribution 2007 and 2008 responses for SEC question 10 (n = 10).



that none of the teachers responded that they taught science for over 25 weeks in the 2007 or 2008 SEC, and that the same teacher provided no response in either year. When

looking at the individual responses to this question it appears that the annual number of weeks allocated for teaching is fairly stable with only three teachers indicating any change between years.

Looking at the individual teacher's responses for the two administrations of the SEC (Table 15), there is little variation. The data indicates that the majority of teachers

Table 15: Matrix showing individual response changes for question 10 between the 2007 and 2008 administration of the SEC.

	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	1	2	2	2	1	2	2	2	1	X
2008	2	2	1	2	2	2	2	2	1	X

1 = 1 to 12 weeks, 2 = 13 to 24 weeks, 3 = 25 to 36 weeks, X = no response

in the sample teach one to two hours of science a week during 30 – 40 minute sessions for 13 to 24 weeks a year. When looking at the data disaggregated by teacher, responses to the average length of each class period for this targeted Science class (question 9) shows the most change, while the overall data for this question does not reflect this level of individual change.

Weekly Teaching Survey

In the spring of 2008, teachers in the study agreed to complete eight weekly surveys that asked them to reflect back on their science teaching for the previous week. This 25 question instrument (Appendix D), discussed in detail in Chapter Three of this dissertation, contains questions derived from the SEC, Horizon's Classroom Observation Protocol (COP), and the Cultural Inclusion Survey (CIS) and has questions that focus on

specific teaching practices and the time allocated to each of theses instructional strategies during the week, questions about cultural integration, and teacher identified influences that drove their science teaching during the week. The first question from this survey asks teachers to record how much time in minutes they spent teaching science each day during the past week. This question, while similar to SEC questions 8 and 9, provides more than one data point for the teaching year and will help to measure the accuracy of teacher responses on the SEC. The data collected and analyzed from 80 individual surveys showed that the average amount of instructional time devoted to science each week is 98.25 minutes per teacher or 1.64 (SD = 1.35) hours per week. This result is somewhat less than the mean 1.9 hours reported on the SEC question. However, when considering the large standard deviation for the WTS, the instructional time reported in Table 16 shows that there is considerable variation among the teachers.

Table 16: Matrix showing individual average weekly science teaching time in hours based on responses to question 1 on the WTS.

Hours	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
M	0.81	1.77	3.57	2.58	1.42	0.63	1.07	2.29	1.74	0.31
SD	0.14	0.73	2.54	0.66	1.26	0.37	0.88	0.27	0.7	0.04

Table 17 shows how science teaching was distributed across the days of the week, and how many minutes per day were devoted to science. Science was taught on 217 of the 400 days monitored in the 80 weekly surveys, and was not taught on 183 days. The

most science teaching occurred on Thursdays and the least happened on Mondays and Fridays.

Table 17: Frequency distribution of science teaching minutes by day (n = 80).

Minutes	Monday	Tuesday	Wednesday	Thursday	Friday	Totals
None	34	26	41	25	57	183
1 to 10	7	5	5	7	4	28
11 to 20	8	14	7	8	7	44
21 to 30	8	15	12	20	6	61
31 to 40	3	0	0	1	0	4
41 to 50	12	16	8	15	4	49
51 to 60	1	1	1	0	1	4
61 to 90	5	1	4	1	0	11
91 to 245	2	2	2	3	1	10

Table 17 also provides information on science lesson length. On 61 of the 217 days when science was taught the teachers reported 21 – 30 minutes of science instruction per day. All in all, science instruction lasted 30 minutes or less, on 133 of the 217 days when science was taught. The WTS asks teachers to provide the actual number of minutes science was taught each day, and perhaps as a result, the WTS findings differ strikingly from the SEC findings that the teachers' science lessons typically lasted 30 to 40 minutes (the shortest response category available on the SEC). Indeed, 61.3% of the science lessons reported on the WTS lasted 30 minutes or less.

Scoop Notebook

In the spring of 2008, the teachers in my sample took part in a graduate level science content course as part of their BSSP participation, which included an activity

designed to help researchers and staff from the BSSP understand typical science teaching and assessment practices for the teachers in the BSSP professional development program. Teachers were introduced to the Scoop Notebook, a tool developed by the Center for Evaluation, Standards, and Student Testing (CRESST) as an alternative approach for characterizing classroom practice by using a "scoop" of materials or a sample of instructional artifacts from classrooms (Borko, Stecher, and Kuffner, 2007). The Scoop Notebook assessment asked teachers to "scoop" materials from a three to five science lesson series as well as to provide pre, mid, and post reflections for the lessons. The Scoop Notebook includes a calendar that estimates the length of the science lessons. The teachers in my sample all produced Scoop Notebooks; however, not all portions of the notebook were complete and thus my data is limited to the Scoops with complete, or properly filled out calendars. Table 18 provides a window into the amount of time given to science instruction when teachers are meeting the expectations of a graduate course that is one aspect of their participation in the BSSP, and therefore may not adequately reflect the time typically devoted to science teaching during an average week. While Scoop lessons sometimes occurred during one week of teaching, several of the teachers presented their lessons over more than one week as part of a unit. The times indicated below are per lesson, and the time reported for four or five lessons should not be equated with the amount of science teaching time allotted for one week. The data shows that the length of the Scoop science lessons typically falls in the range of 30 (7/30) to 45 (7/30) minutes. Together, lessons of 30 and 45 minutes account for 14/30 or 46.6% of all Scoop lessons.

This typical lesson length, while similar to that reported in the SEC, does not agree with the time commonly reported on the WTS. Indeed 63.3% of the Scoop lessons fell between 45 to 120 minutes. This presents a clear contrast to the WTS results showing slightly over 60% of all science lessons lasting 30 minutes or less.

Table 18: Matrix of teacher reported science teaching time by lesson as found in Scoop Notebook Calendar.

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
Heather	45	45	45	120	X
Christina	50	50	50	50	50
Melissa	50	45	45	60	X
Angela	25	30	45	60	45
Sarah	30	30	30	30	30
Michelle	80	80	60	X	X
Jessica	25	20	30	20	X

Interviews

In early June 2008, shortly after the conclusion of the first year of the BSSP, teachers in my sample were interviewed to better understand their schools and their teaching situations. Additional questions regarding the influences that the teachers felt have the greatest impact on their teaching practice were also asked. Responses to questions that asked the teachers to think about what they feel drives the amount of time they teach a specific content varied and included:

> And, so my time for science was ten or fifteen minutes, like every other day. Which averages out to about, you know, anywhere between thirty and forty minutes a week but, I didn't think that was too bad for what I am having to do (Jessica).

> Seems like if I teach it at all, I have to grab time from here or there or someplace. And, like I said, we just don't have a lot of time for it so that

> influences it quite a bit. It usually, a lot of the time I end up doing something just out of the book because I've got fifteen, twenty minutes, thirty minutes and you really can't set up for anything hands-on in that amount of time (Melissa).
>
> We have a very limited time schedule. So we're maybe allowed an hour a week to teach science (Angela).
>
> And we had, you know, little time each week (Sarah).
>
> I did have plenty of science teaching time at the end of the day because, social studies and science was kind of slack and open at the end of the day. And I could use that time; however, I wanted to. And on Friday I actually had a solid hour and, and I was just thankful (Tiffany).

The other interview responses didn't tie directly to the amount of time that the teachers have to teach science; however, there was a general theme that the time allocated for science was limited by the amount of time needed by mathematics and English language arts. This influence will be addressed in greater detail in the section of this chapter that focuses on influences on teaching.

The interviews show that the amount of science teaching time ranges from around 40 minutes a week to "a solid hour" on a Friday. This range aligns well with the weekly averages reported on the WTS for these teachers. For example, Jessica reported that she has, "anywhere between thirty and forty minutes a week" to teach science, which agrees with her WTS average of 37.5 minutes per week. Tiffany commented that she "actually had a solid hour" to teach on Friday's which is reflected in the WTS with a weekly average science teaching time of 64.1 minutes, slightly more than an hour. Melissa said that she usually "got fifteen, twenty minutes, thirty minutes" a day which also agrees with her WTS average or 106.1 minutes a week. Angela commented that she was "maybe allowed an hour a week to teach science", while her WTS indicated that she had closer

to an hour and 25 minutes on average to teach science each week. While Angela's interview data and WTS data don't align as well as the other teachers, it is safe to say that the teachers are consistent in reporting their science teaching time when one compares their WTS weekly averages with the comments from their interviews.

Summary of Science Teaching Time Data

Taken collectively the data from the SEC, the WTS, the Scoop Notebook, and interviews indicate that the teachers in this sample teach science on average between 1.64 hours a week (WTS) and 1.8 - 1.9 hours per week (SEC). Furthermore, when teachers record the actual amount of time spent teaching science per day, as on the WTS, tremendous variation between teachers and across the days and weeks monitored is evident. This variability in teachers' science teaching schedules is one of the most striking finding of this study, and is most clearly evident in the WTS data. The largest number of individual science lessons taught last between 21 and 30 minutes. While a large number of science lessons took between 21 and 30 minutes, several lessons took as little as five minutes and one was allocated 245 minutes, with an average of 19.6 minutes per lesson across the 400 possible teacher-days covered in the WTS. Of the 400 possible teaching days monitored, in 183 (45.8%) there was no science teaching leaving only 217 days when science was taught. On 61 of the 217 (28%) of days when science was taught the teachers reported 21-30 minutes of science instruction per day and in 72 of the 217 (33%) days science instruction lasted 20 minutes or less. This means that in 84 of the 217 (38%) days science was taught for longer than 30 minutes. An additional artifact of the WTS was the distribution of science teaching by day with the least amount of science

teaching (23/217 lessons or 10.6%) occurring on Fridays and the most on Tuesdays and Thursdays with 109/217 lessons or (50.2%).

When comparing the results of participants in this study to national studies (e.g., NAEP, SASS, the National Survey of Science and Mathematics), and regional studies (e.g., Montana SEC) it is clear that the teachers in this study do not teach science for the same time on average as reported by teachers in these other studies, although these large scale studies show wide variability across instructors. Based on results from the two administrations of SEC, the WTS and interviews, the teachers in this study indicated that they teach science on average between 1.64 hours per week, falling short of national (e.g., NAEP (2.1 hours), SASS (2.04 hours), the National Survey of Science and Mathematics (2.1 hours)) and regional averages (e.g., Montana SEC (2.9 hours)). While the teachers in my study may not regularly be teaching science for as long a period as their counterparts in the national and regional studies reported here, they are still teaching science and the WTS appears to have produced more accurate responses than the retrospective answers provided in the national and regional studies.

The next section of this paper will focus on what the science teaching of the BSSP teachers in my study looks like, with particular attention to how the science is presented to students and the teacher's attention to the cultural needs of the students.

How The Teachers Are Using Their Science Teaching Time

In the previous section of this chapter the discussion focused on what the data revealed about the amount of time that the teachers in my sample were devoting to the

teaching of science. The Weekly Teaching Survey (WTS) data indicated that the teachers are teaching science, generally on a weekly basis, between one and a half and two hours while the SEC indicated that 2/3 of the teachers were teaching roughly this same amount of time for 12 to 24 weeks. Possible reasons for this difference could be attributed to the response choices on SEC and that the WTS was run in conjunction with the teachers Scoops. The following section of this chapter will begin to look at what the various data sources tell us regarding the second research question that looks at how the teachers who teach science allocate their time for science instruction. Specifically how do the teachers in my study use the time they have and how closely does their practice reflect best practices in science, as recommended by the National Science Education Standards and related research literature. Best practices in science are defined by Mistrell and Kraus (2005) as those that address students' initial understanding and preconceptions about science topics, provide a foundation of both conceptual understanding and factual knowledge, help the students take control of their own learning, and supports collaboration among the students and with the teacher. Also of interest to this study is how responsive the teaching is to local tribal culture and contexts.

Survey of Enacted Curriculum

As mentioned in the previous section of this chapter, the SEC has been given twice, in early June 2007 and early June 2008. The data from both administrations will be discussed, with attention given to the questions that address the research question that focuses on how the teachers use their science teaching time in regard to the time their

students are engaged in specific activities. The SEC questions align with research and policy recommendations for best practices in science. In the survey instrument, the questions are grouped into sections that look at the amount of instructional time devoted to specific categories of recommended practices. A copy of the complete instrument is found in Appendix A for reference. Questions 25 through 36 deal with a variety of teaching activities including: listening to the teacher explain something to the whole class, working individually on science assignments, doing a laboratory, taking a quiz or test, working in small groups or pairs, and other activities typically in science classrooms. Teachers are asked to estimate the amount of science instructional time that a typical student spends *over the course of an entire school year* engaged in each activity with Likert choices for time engaged including: 0 = none, 1 = little (10% or less), 2 = some (11 – 25%), 3 = moderate (26 – 50%), and 4 = considerable (50% or more). The second section, questions 37 through 45 pertain specifically to teaching practice when the students are engaged in laboratory activities, investigations, or experiments as part of the science instruction. Questions 46 through 51 target the time spent on various instructional activities while the students are working in small groups or pairs, and questions 52 to 56 look at the amount of instructional time devoted to collecting science data or information in settings other than laboratories. Questions 57 to 62 focus on instructional time devoted to specific activities using educational technology including calculators and computers. While this data is important and I will include it in this study it is important to note that some of the teachers in my study have no access, or difficult

access, to these technologies making interpretation of data about technology use challenging.

As I mentioned previously, questions 25 to 36 focus on the amount of science teaching time devoted to various instructional practices that reflect recommendations of Mistrell and Kraus (2005), the National Science Education Standards (NSES), American Indian Science and Engineering Society (AISES), and Center for Research on Education, Diversity and Excellence (CREDE). These questions, 25 to 36, (Table 19) are generic in nature and designed to provide an over all image of the teacher's science teaching practice. They also provide a foundation for several subsequent subsections on the SEC. Questions 29, 31, 32, and 34 are expanded in later sections of the SEC to further delineate specific practices associated with these overarching categories (in italics in Table 19).

Table 19: SEC questions 25 to 36 with questions that are expanded in later subsections of the SEC in *italic* font.

25. Listen to the teacher explain something to the class as a whole about science.
26. Read about science in books, magazines, articles (not textbooks).
27. Work individually on science assignments.
28. Write about science in a report/paper on science topics.
29. Do a laboratory, investigation, or experiment.
30. Watch the teacher demonstrate a scientific phenomenon.
31. Collect data (other than laboratory activities).
32. Work in pairs or small groups (other than laboratory activities).
33. Do a science activity with the class outside the classroom or laboratory.
34. Use computers, calculators, or other educational technology to learn science.
35. Maintain and reflect on a science portfolio of their own science work.
36. Take a quiz or test.

The average of the responses for the teachers in my sample on the 2007 SEC provides a mean of 1.91 (*SD* = 0.58) indicating that the teachers spend "some" time on these practices as a whole. The results for the 2008 SEC provided a mean of 1.84 (*SD* = 0.45) suggesting that there was not much change in practice between the two years. These averages are an inadequate interpretation of practice since the large standard deviations indicate wide variability across items. To look deeper I disaggregated the data by teacher (Table 20), which shows that the range in averages is considerable, particularly when looking at the 2007 SEC. These individual teacher averages, like the overall averages,

Table 20: Average response to SEC questions 25 to 36, disaggregated by teacher and year.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	*M*	2.0	1.7	2.4	2.2	1.7	2.1	2.3	2.2	2.1	0.4
	SD	1.21	1.23	0.79	0.87	0.96	0.58	0.65	0.87	1.24	0.79
2008	*M*	1.6	1.3	1.8	2.1	1.5	1.7	2.5	1.6	2.6	1.4
	SD	0.79	1.23	1.06	1.16	1.17	0.78	1.24	0.67	0.67	0.79

0= none, 1 = little (<10%), 2 = some (11 - 25%), 3 = moderate (26 - 50%), 4 = considerable (>50%)

indicate wide variability between teachers and for year to year for individual teachers and again are an inadequate tool for understanding practice. To more fully understand how the science teaching time looks for these teachers I have constructed two tables. Table 21 provides distributions of the number of each type of response for twelve questions in this initial section of the SEC for both administrations and the degree of change for each of these Likert responses. For example, for question 28 (write about science in a paper or report), six teachers responded that their students did this "some" of the time during the

Table 21: Distribution of teachers regarding the amount of time devoted to various instructional practices (questions 25 – 36).

Positive Change in number of teachers by practice and time allocated
Negative Change in number of teachers by practice and time allocated
No Change in number of teachers by practice and time allocated

	None			Little (10% or less)			Some (11-25%)			Moderate (26-50%)			Considerable (50% or more)		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
25. Listen to the teacher in whole class environment	1	0	-1	1	2	1	3	4	1	4	4	0	1	0	-1
26. Read about science in books etc (not text)	0	0	0	1	4	3	5	5	0	4	1	-3	0	0	0
27. Work individually on science	1	0	-1	3	3	0	3	5	2	1	2	1	2	0	-2
28. Write about science in a paper or report	0	2	2	4	7	3	6	0	-6	0	1	1	0	0	0
29. Do a laboratory, investigation, or experiment	1	0	-1	1	2	1	3	1	-2	4	6	2	1	1	0
30. Watch teacher do a science demonstration	1	0	-1	2	1	-1	5	6	1	1	1	0	0	1	1
31. Collect data (other than laboratory)	2	0	-2	1	4	3	2	5	3	5	1	-4	0	0	0
32. Work in pairs or small groups (other than laboratory)	1	0	-1	1	0	-1	2	2	0	3	6	3	3	2	-1
33. Do a science activity with the class Outside the classroom	1	3	2	5	4	-1	3	2	-1	1	1	0	0	0	0
34. Use computers, calculators, tech to learn science	0	2	2	2	4	2	7	2	-5	0	1	1	1	1	0
35. Maintain and reflect on a science portfolio of own work	4	3	-1	2	5	3	3	0	-3	1	2	1	0	0	0
36. Take a quiz or test	1	1	0	2	4	2	4	3	-1	3	2	-1	0	0	0

Table 22: Individual teacher responses regarding the amount of time devoted to various instructional practices (questions 25 – 36).

0 = None
1 = Little (<10%)
2 = Some (11-25%)
3 = Moderate (26-50%)
4 = Considerable (>50%)

Positive Change in time allocated
Negative Change in time allocated
No Change in time allocated

	Sarah			Melissa			Christina			Heather			Angela		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
25. Listen to the teacher in whole class environment	2	2	0	3	1	-2	2	3	1	1	3	2	3	3	0
26. Read about science in books etc (not text)	3	1	-2	3	1	-2	2	2	0	3	1	-2	2	1	-1
27. Work individually on science	1	2	1	4	2	-2	2	2	0	4	3	-1	1	2	1
28. Write about science in a paper or report	1	1	0	1	1	0	2	0	-2	2	1	-1	1	1	0
29. Do a laboratory, investigation, or experiment	3	3	0	1	0	-1	3	3	0	3	3	0	3	2	-1
30. Watch teacher do a science demonstration	3	2	-1	1	3	2	2	2	0	2	3	1	2	2	0
31. Collect data (other than laboratory)	3	1	-2	1	1	0	3	2	-1	3	3	0	2	2	0
32. Work in pairs or small groups (other than laboratory)	4	3	-1	1	4	3	3	2	-1	2	3	1	3	3	0
33. Do a science activity with the class Outside the classroom	1	1	0	1	0	-1	1	0	-1	2	1	-1	1	0	-1
34. Use computers, calculators, tech to learn science	2	1	-1	1	1	0	4	3	-1	2	0	-2	2	0	-2
35. Maintain and reflect on a science portfolio of own work	0	1	1	0	0	0	3	1	-2	1	1	0	0	0	0
36. Take a quiz or test	1	1	0	3	1	-2	2	1	-1	2	3	1	1	1	0

Table 22 Continued: Individual teacher responses regarding the amount of time devoted to various instructional practices (questions 25 – 36).

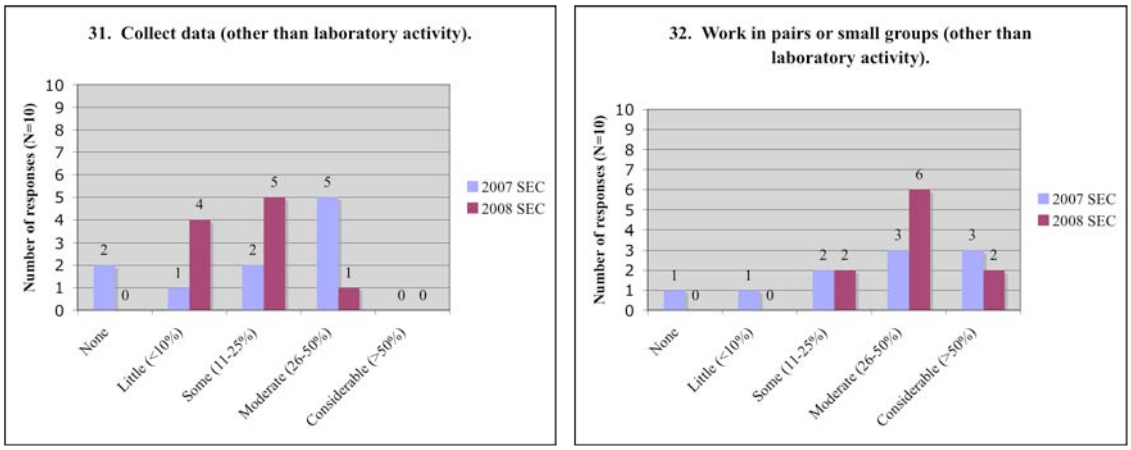
	Jessica			Tiffany			Rebecca			Michelle			Kimberly		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
25. Listen to the teacher in whole class environment	3	2	-1	2	2	0	3	1	-2	4	3	-1	0	2	2
26. Read about science in books etc (not text)	2	2	0	2	2	0	3	2	-1	2	3	1	1	2	1
27. Work individually on science	3	1	-2	2	1	-1	2	2	0	1	3	2	0	1	1
28. Write about science in a paper or report	2	1	-1	2	1	-1	1	1	0	2	3	1	2	1	-1
29. Do a laboratory, investigation, or experiment	2	1	-1	2	4	2	2	2	0	4	3	-1	0	1	1
30. Watch teacher do a science demonstration	2	2	0	2	4	2	2	2	0	1	2	1	0	1	1
31. Collect data (other than laboratory)	2	1	-1	3	2	-1	3	2	-1	0	2	2	0	1	1
32. Work in pairs or small groups (other than laboratory)	2	3	1	4	4	0	4	2	-2	3	3	0	0	3	3
33. Do a science activity with the class Outside the classroom	1	1	0	2	1	-1	2	2	0	3	3	0	0	2	2
34. Use computers, calculators, tech to learn science	2	2	0	2	4	2	2	1	-1	1	1	0	2	2	0
35. Maintain and reflect on a science portfolio of own work	2	1	-1	2	3	1	1	0	-1	2	3	1	0	1	1
36. Take a quiz or test	3	3	0	3	2	-1	2	2	0	2	2	0	0	0	0

2007 school year, while no teacher made this response in 2008, giving a change in the negative direction of six teachers. This table looks at the changes in responses for these questions between the two administrations from the perspective of the whole sample and provides similar data from each individual teacher in the sample by looking at the change in amount of time they allocated for each activity. Additionally I have provided frequency distributions for each of the questions for the ten teachers in the sample, giving data for both 2007 and 2008 in Appendix F.

The results of the SEC across 2007 and 2008 show changes in number of teachers in each category for the activities and changes within categories for an individual teacher for the activities. These changes between administrations of the SEC suggest that there is no clear indication if the teacher's practice is moving toward practices recognized as being best practice in science, or if their practice is moving away from these practices. When looking at individual teacher responses (see Table 22 above), the data indicated that teachers do not experience change in a uniform way and are equally as likely to move toward a particular practice in science as away from it.

Figure 10 represents the frequencies of the responses to questions 31 and 32. These questions are indicators of how teachers engage their students in collecting data in situations other than a laboratory (question 31) and the amount of time students engage in pair and small group work outside of the laboratory (question 32). These questions show the greatest change when comparing responses from 2007 to 2008 and may be tied to the

Figure 10: Frequency distributions graphs for SEC questions 31 and 32 in both 2007 and 2008 administrations.



teacher's participation in the BSSP and will be discussed further in a later section of this chapter. The graph for question 32 indicates that all of the teachers used pair and small group work with their students at least some (11 – 25%) of the time and that six of the ten teachers provided the students opportunities to work collaboratively a moderate (26 - 50%) amount of the time. Collaboration is one of the strategies identified in Chapter Two as a component of culturally responsive curriculum and 2008 SEC indicate that the teachers in my sample are making an effort to provide collaborative experiences. The 2008 SEC data indicates that the teachers had increases in the amount of teaching time they provided for their students to collect data, work collaboratively, and do laboratory activities, with no teachers reporting a "none" for these three questions. However, the data also indicates that some desirable activities saw decreases in allocated time from 2007 to 2008, with more teachers indicating "none" responses on questions 28, 33, and 34 indicating that fewer teachers in the sample had their students engaged in writing

about science, doing science activities outside of the classroom, and using technology in 2008 than they did in 2007.

Questions 25 to 36 addressed the amount of time that teachers allocate to a variety of science teaching activities during a year. The data for 2008 shows a slight increase in the amount of time devoted to laboratory activities, investigations or experiments (question 29), as well as the amount of time provided to students to work in pairs and small groups (other than laboratory) (question 32). In this section of the chapter I will discuss the changes the data reflects about the amount of instructional activities specific to laboratories (questions 37 – 45, see Table 23), pair and small group other than in the science laboratory (questions 46 – 51), and collecting science data or information other than during laboratory experiences (questions 52 – 56). As with the previous section on

Table 23: SEC questions 36 to 45 expand the responses category established by question 29 in the previous section of the SEC.

37. Make educated guesses, predictions, or hypotheses.
38. Follow step-by-step directions.
39. Use science equipment or measuring tools.
40. Collect data.
41. Change a variable in an experiment to test a hypothesis.
42. Organize and display information in tables or graphs.
43. Analyze and interpret science data.
44. Design their own investigation or experiment to solve a scientific question.
45. Make observations/classifications.

questions 25 – 36, I will look at the changes in responses for these questions between the two administrations from the perspective of the whole sample as well as by individual teacher reports.

Looking at the laboratory related activities subgroup (items 37 – 45), and averaging

the responses of all the teachers in the sample, it appears that there was little overall change in the amount of teaching time devoted to science associated with laboratory, investigation, or experimentation with a mean of 2.03 (*SD* = 0.69) in 2007 and a mean of 1.98 (*SD* = 0.61) in 2008. These means indicate that overall practice for the teachers in my sample includes activities associated with laboratory generally "some" (11 - 25%) of the time. As with the previous section, these averages are an inadequate interpretation of practice. Therefore I have disaggregated the data by teacher (Table 24), which shows that the range in averages is considerable, particularly when looking at the 2007 SEC.

Table 24: Average response to SEC questions 37 - 45, laboratory and non-laboratory related activities disaggregated by teacher and year.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	*M*	2.3	0.9	2.8	1.9	2.5	2	1.9	1.8	3.1	1.1
	SD	1.12	0.78	0.44	1.09	0.88	0	0.6	0.44	0.93	1.7
2008	*M*	2.3	1.2	1.8	3	1.6	1.4	2.1	1.7	2.9	1.6
	SD	1.32	0.97	0.44	1.12	1.24	0.53	0.33	0.5	1.05	0.73

0 = none, 1 = little (<10%), 2 = some (11 - 25%), 3 = moderate (26 - 50%), 4 = considerable (>50%)

Individual teacher averages, like the overall averages, indicate that there was variation between the years for these teachers. The exception was Sarah, who had the same average for lab related activities both years. It is interesting to note that four of the teachers increased their average "laboratory activity" time with one teacher, Heather, indicating a gain of more than a point. Heather increased the amount of teaching time devoted to activities associated with laboratory, investigation, and experiments from "some," or between 11 and 25%, to "moderate," or between 26 and 50% of the time during the year. Half of the teachers in the sample had decreases in these same activities according to their

Table 25: Distribution of SEC responses for regarding laboratory and non-laboratory related activities (questions 37 – 45).

Positive Change in number of teachers between 2007 and 2008
Negative Change in number of teachers between 2007 and 2008
No Change in number of teachers between 2007 and 2008

	None			Little (10% or less)			Some (11-25%)			Moderate (26-50%)			Considerable (50% or more)		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
37. Make educated guesses, predictions, or hypothesis	0	0	0	3	1	-2	3	5	2	3	1	-2	1	3	2
38. Follow step-by-step instructions	0	0	0	1	0	-1	4	6	2	3	2	-1	2	2	0
39. Use science equipment or measuring tools	1	0	-1	0	3	3	4	5	1	4	0	-4	1	2	1
40. Collect data	0	0	0	2	2	0	3	5	2	5	2	-3	0	1	1
41. Change a variable in an experiment to test a hypothesis	0	1	1	4	5	1	4	4	0	2	0	-2	0	0	0
42. Organize and display data in table or graphs	0	1	1	2	2	0	5	5	0	3	2	-1	0	0	0
43. Analyze and interpret science data	0	0	0	4	5	1	4	4	0	2	1	-1	0	0	0
44. Design their own investigation or experiment	3	3	0	5	6	1	2	1	-1	0	0	0	0	0	0
45. Make observations/classifications	1	0	-1	1	1	0	3	3	0	3	5	2	2	1	-1

Table 26: Individual teacher SEC responses regarding laboratory and non-laboratory related activities (questions 37 – 45).

0 = None
1 = Little (<10%)
2 = Some (11-25%)
3 = Moderate (26-50%)
4 = Considerable (>50)

Positive Chang in category between 2007 and 2008
Negative Change in category between 2007 and 2008
No Change in category between 2007 and 2008

	Sarah			Melissa			Christina			Heather			Angela		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
37. Make educated guesses, predictions, or hypothesis	3	4	1	1	2	1	3	1	-2	1	4	3	3	3	0
38. Follow step-by-step instructions	1	3	2	2	2	0	3	2	-1	3	4	1	3	3	0
39. Use science equipment or measuring tools	3	1	-2	2	1	-1	3	2	-1	3	4	1	3	2	-1
40. Collect data	3	3	0	1	1	0	3	2	-1	3	4	1	3	1	-2
41. Change a variable in an experiment to test a hypothesis	2	1	-1	0	0	0	2	2	-1	1	2	1	2	1	-1
42. Organize and display data in table or graphs	3	3	0	1	1	0	3	2	-1	2	3	1	2	0	-2
43. Analyze and interpret science data	1	1	0	1	1	0	3	2	-1	1	2	1	2	1	-1
44. Design their own investigation or experiment	1	1	0	0	0	0	2	1	-1	0	1	1	1	0	-1
45. Make observations/ classifications	4	4	0	0	3	3	3	2	-1	2	3	1	4	3	-1

Table 26 Continued: Individual teacher SEC responses regarding laboratory and non-laboratory related activities (questions 37 – 45).

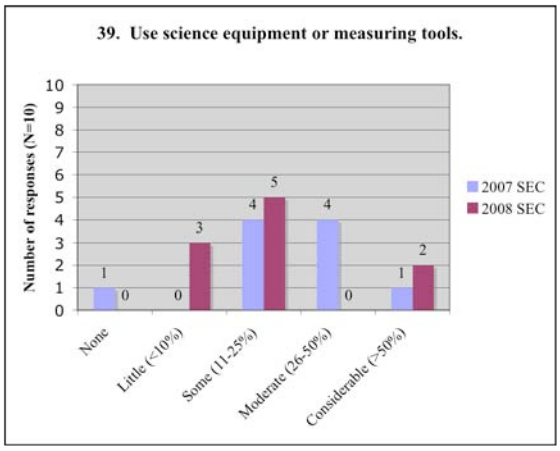
	Jessica			Tiffany			Rebecca			Michelle			Kimberly		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
37. Make educated guesses, predictions, or hypothesis	2	2	0	2	2	0	2	2	0	4	4	0	1	2	1
38. Follow step-by-step instructions	2	2	0	2	2	0	2	2	0	4	4	0	4	2	-2
39. Use science equipment or measuring tools	2	1	-1	2	2	0	2	2	0	4	4	0	0	2	2
40. Collect data	2	2	0	2	2	0	2	2	0	3	3	0	1	2	1
41. Change a variable in an experiment to test a hypothesis	2	1	-1	1	2	1	1	1	0	3	2	-1	1	1	0
42. Organize and display data in table or graphs	2	2	0	2	2	0	2	2	0	3	2	-1	1	1	0
43. Analyze and interpret science data	2	1	-1	2	2	0	2	1	-1	3	3	0	1	2	1
44. Design their own investigation or experiment	2	1	-1	1	2	1	1	1	0	1	1	0	0	0	0
45. Make observations/classifications	2	1	-1	2	1	-1	2	2	0	3	3	0	1	2	1

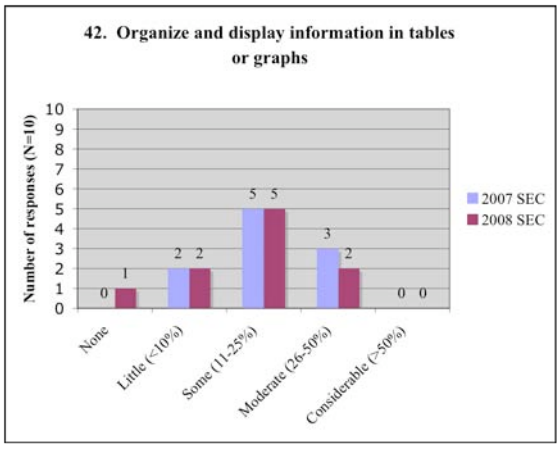
2007 and 2008 SEC responses. It is interesting to note that two teachers, Christina and Angela, indicated that the amount of time they devote to laboratory activities decreased between 2007 to 2008 from 11 - 25% (some) to <10% (little) science teaching time. To more fully understand how science teaching time looks in the laboratory setting for these teachers, I have constructed two tables similar to those in the previous section. Table 25 (above), above, provides distributions of the number of each type of response for nine questions in the SEC (items 37 - 45) associated with laboratory, investigation, or experimental activities. When looking at the data on Table 26 (above), one can see that the largest overall change between 2007 and 2008 involves question 39 (use science equipment or measuring tools), and question 40 (collect data). The number of teachers reporting their students engaged in these activities a "moderate" (26 – 50%) amount of the time, declined by three and four respectively. This was only slightly offset by one additional respondent selecting the "considerable" (>50%) amount of time response option for the same questions. It is interesting to note that for seven of the nine questions, there were decreases in the "moderate" (26 – 50%) response, and that these were partially or entirely offset by increases in the "considerable" (>50%) category for three questions. For the other questions and other response choices there was no clear indication of directional trend between the 2007 and 2008 SEC. Table 26 (above), provides similar data for the individual teachers in the sample and reveals that Rebecca and Michelle had relatively little change in their responses between years, suggesting that

their practice in 2008 was similar to that in 2007. Christina had reduction in her practices for all the questions in this section of the SEC, suggesting that she decreased each of these activities in 2008. Heather, on the other hand, had an increase in time reported for lab-related activities in 2008, suggesting that she spent more of her teaching time engaging her students in such activities. The responses of the other six teachers in the sample showed variability responses between the 2007 and 2008 SEC administrations indicating that they were just as likely to be moving toward laboratory and investigative activities as moving away from them.

A sample of the frequency distributions for questions 39 and 42 (Figure 11) is provided to help the reader better visualize the variability between questions in this section of the SEC. For some questions, 42 for example, there is great similarity in the data between the two administrations of the SEC and for other questions, such as 39, there is little similarity indicating that students' experiences or teachers' practice were

Figure 11: Frequency distributions graphs for SEC questions 39 and 42 in both 2007 and 2008 administrations of the instrument.

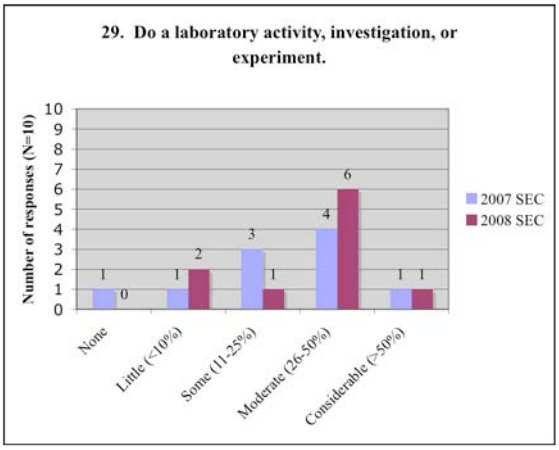




difficult to capture using the SEC alone.

Questions 37 to 45 on the SEC build upon question 29 (do a laboratory, investigation, or experiment) and provide more response options that directly address the amount of time that teachers allocate to these activities during a typical school year. The teachers' responses to question 29 (Figure 12) in 2008 suggested the teachers in the sample had an increase in laboratory activities from 2007. Yet the teachers' responses to questions 39 - 45 give a less clear-cut result. There were net increases in time devoted to four of the activities including make educated guesses (question 37), using equipment (question 39), collecting data (question 40), and making observations (question 45), yet slight decreases in time devoted to five other activities associated with laboratories and investigative science.

Figure 12: Frequency distribution graph for SEC question 29 for both 2007 and 2008 administrations of the instrument.



The next section of the chapter will discuss the changes the data reflects about the amount of instructional activities specific to pair and small group work outside of the

science laboratory (questions 46 – 51). Pair and small group work both provide opportunities for students to learn collaboratively and as mentioned in Chapter Two, has been recognized as one component of culturally responsive curriculum. Teacher responses to question 32 on the 2007 and 2008 SEC indicate that the teachers in my sample are making an effort to provide their students with more opportunities to work collaboratively. Question 32 indicated that the average amount of time devoted to pair and group work increased from a mean of 2.6 (*SD* = 1.35), or roughly between "some" and "moderate" in 2007 to a mean of 3.0 (*SD* = 0.67), or "moderate" in 2008. These averages are an inadequate interpretation of practice; therefore, Table 27 has been constructed to provide data disaggregated by teacher, which shows that the range in averages is considerable, particularly when looking at the 2007 SEC. It is also

Table 27: Average response to SEC questions 46 – 51 regarding amount of instructional time in pairs or small groups other than during science in laboratory settings.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	*M*	1.2	0.5	2.7	1.2	2	1.3	1.7	0.8	2.7	0.7
	SD	0.75	1.22	0.52	0.75	0.82	0.52	0.82	0.71	0.82	0.75
2008	*M*	1.7	0.3	1.7	1.8	1	0.8	2	1.2	2.2	1.2
	SD	0.82	0.52	0.82	1.17	0.89	0.98	0	0.75	0.72	0.98

0 = none, 1 = little (<10%), 2 = some (11 - 25%), 3 = moderate (26 - 50%), 4 = considerable (>50%)

interesting to note that when the section of questions focusing on teaching activities when students are engaged in pair and small groups are averaged across the sample for questions 46 to 51, the average amount of time devoted to pair and group work slightly decreased from a mean of 1.48 (*SD* = 0.78), or roughly between "little" and "some" in 2007 to a mean of 1.38 (*SD* = 0.58) in 2008. This result disagrees with teacher reported data for

Table 28: Distribution of SEC responses regarding small non-laboratory group and pair activities (questions 46 – 51).

Positive Change in number of teachers between 2007 and 2008

Negative Change in number of teachers between 2007 and 2008

No Change in number of teachers between 2007 and 2008

	None			Little (10% or less)			Some (11-25%)			Moderate (26-50%)			Considerable (50% or more)		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
46. Talk about ways to solve science problems	2	0	-2	1	3	2	4	6	2	3	1	-2	0	0	0
47. Complete written assignments from the text or workbook*	1	1	0	1	4	3	4	3	-1	3	2	-1	0	0	0
48. Write up results or prepare a presentation from lab, etc.	1	2	1	6	4	-2	0	3	3	3	1	-2	0	0	0
49. Work on an assignment, report, or project (1 week +)	1	2	1	4	2	-2	2	5	3	3	1	-2	0	0	0
50. Work on a writing project or entries for portfolio peer comments	4	6	2	3	3	0	2	1	-1	1	0	-1	0	0	0
51. Review assignments or prepare for a quiz or test	1	2	1	7	1	-6	1	6	5	1	1	0	0	0	0

* 9 responses for this activity

Table 29: Individual teacher SEC responses regarding small non-laboratory group and pair activities (questions 46 – 51).

0 = None
1 = Little (<10%)
2 = Some (11-25%)
3 = Moderate (26-50%)
4 = Considerable (>50%)

Positive Change in category between 2007 and 2008
Negative Change in category between 2007 and 2008
No Change in category between 2007 and 2008

	Sarah			Melissa			Christina			Heather			Angela		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
46. Talk about ways to solve science problems	2	3	1	0	1	1	3	2	-1	0	2	2	2	2	0
47. Complete written assignments from the text or workbook*	1	1	0	3	1	-2	2	1	-1	2	3	1	3	1	-2
48. Write up results or prepare a presentation from lab, etc.	1	2	1	0	0	0	3	1	-2	1	3	2	3	1	-2
49. Work on an assignment, report, or project (1 week +)	2	2	0	0	0	0	3	3	0	2	1	-1	3	2	-1
50. Work on a writing project or entries for portfolio peer comments	0	1	1	0	0	0	3	1	-2	1	0	-1	2	0	-2
51. Review assignments or prepare for a quiz or test	1	1	0	0	0	0	2	2	0	1	2	1	1	0	-1

	Jessica			Tiffany			Rebecca			Michelle			Kimberly		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
46. Talk about ways to solve science problems	2	1	-1	3	2	-1	2	1	1	3	2	-1	1	2	1
47. Complete written assignments from the text or workbook*	2	2	0	2	2	0	X	2	N/A	3	3	0	0	0	0
48. Write up results or prepare a presentation from lab, etc.	1	0	-1	1	2	1	1	1	0	3	2	-1	1	1	1
49. Work on an assignment, report, or project (1 week +)	1	0	-1	1	2	1	1	1	0	3	2	-1	1	2	1
50. Work on a writing project or entries for portfolio peer comments	1	0	-1	2	2	0	0	0	0	1	1	0	0	0	0
51. Review assignments or prepare for a quiz or test	1	2	-1	1	2	1	1	2	1	3	3	0	1	2	1

* 9 responses for this activity

important to remember that question 32 refers to changes in the amount of time to all activities associated with pair and small group work during a typical school year and, that averages can be skewed by one or two respondents in a small sample. To further understand the data reflecting teaching practice while students are engaged in small non-laboratory group and pair activities I have constructed two tables similar to those in the previous sections. Table 28 (above) provides distributions of the number of each type of response for the six questions for the whole sample of ten teachers. Table 29 (above) provides similar data for the individual teachers. This data shows that pair and small group activities generally decreased for Christina, Angela, Jessica, and Michelle from 2007 to 2008 and the average pair and small group work for all teachers decreased slightly because of decreases reported by these four teachers. It is important to note that five of the ten teachers in the sample indicated that they devoted more science teaching time to pair and small group activities in 2008 than in 2007 and that for one, Melissa, there was almost no change between the two years. This data suggests that as a group these teachers are slightly increasing the time they provide their students opportunities to work collaboratively. This is significant because collaborative work has been recognized as being a component of culturally responsive teaching for Native American students and best science teaching practice.

The next section of the chapter will discuss the changes the data shows regarding the amount of time devoted to instructional activities specific to collecting science data or information outside of the science laboratory (questions 52 – 56). This section of the SEC expands question 31 (collect data [other than laboratory activities]) for which the

responses indicated that the teachers in my sample reduced the time they provided for their students to collect data outside of laboratory situations. It is important to note that the intent of the questions for this section of the SEC, was to assess instructional time devoted to collecting science data or information from books, magazines, computers, or other sources (other than laboratory activities). The information elicited from these questions is related to SEC question 31 which asks how much of the total science instructional time do students in the target class collect data (other than laboratory activities). SEC questions 52 – 56 ask teachers to report on activities associated with the use of this data and not simply the collection of data outside of laboratory. Data collection as a practice is an activity that is aligned with best science teaching practice, so long as laboratories are also provided for students. While the 2008 data showed an overall decrease in the amount of time devoted to this activity from a mean of 2.0 (*SD* = 1.25), or "some" in 2007 to a mean of 1.7 (*SD* = 0.67), or somewhere between "little" and "some" in 2008, these averages are an inadequate portrayal of practice. Therefore I have provided individual teacher and group data for both question 31 and questions 52 – 56 (Tables 30 – 32). The data for question 31 (collect data during non-laboratory activities) shows that half the teachers in the sample reduced the overall time allocated to data collection, and half the teachers increased their allocation of time in this area. It is important to note that while the overall average decreased for the teachers in the sample, none of the teachers reported that they devoted no time to these activities in 2008. The averages for questions 52 through 56 are similar to the results for question

Table 30: SEC question 31 and averages for questions 52 – 56, which focus on amount of instructional time devoted to the collection of science data or information other than in science laboratory settings.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
Q31	2007	3	1	3	3	2	2	3	3	0	0
	2008	1	1	2	3	2	1	2	2	2	1
Q52-56											
2007	*M*	2.8	0	2.4	1.4	3	2	2	1.6	2.6	0.8
	SD	0.45	0	0.55	0.89	0.71	0	0	0.55	0.55	0.45
2008	*M*	1.8	0.8	2	1.8	2	1.8	3	1.6	2	2
	SD	0.84	0.45	0	0.84	1	0.45	0	0.55	0	0.45

0 = None, 1 = Little < 10%, 2 = Some 11-25%, 3 = Moderate 26-50%, 4 = Considerable >50%

31, with the exception of Michelle who indicated in her response to question 31 in 2007 that she had allocated no time for data collection, yet indicated that she provided between "some" and "moderate" amounts of time for data collection in her response to questions 52 – 56 the same year. One possibility for this discrepancy is that question 31 only addresses data collection and questions 52 - 56 center on activities that encourage students to use the data collected. Looking at the questions in this section (Table 32) reveals that in some cases there is little change in responses between administrations (question 52), and in other cases of the change between years is very obvious (question 55). Question 55 had the greatest change between administrations with six of the teachers reporting that they allocate "some" time for students to analyze and interpret the information or data orally or in writing in 2008, compared to two teachers in 2007. However, there is no clear direction of change since in 2008 there were also fewer teachers selecting the response categories for item 55 bracketing the "some" response. In other words their responses for this item moved toward the middle of the continuum. When reflecting on the individual changes by teacher (Table 32), one can see that Kimberly,

Table 31: Distribution of SEC responses regarding data collection associated with non-laboratory activities (questions 52 – 56).

Positive Change in number of teachers between 2007 and 2008
Negative Change in number of teachers between 2007 and 2008
No Change in number of teachers between 2007 and 2008

	None			Little (10% or less)			Some (11-25%)			Moderate (26-50%)			Considerable (50% or more)		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
52. Have class discussions about data	1	0	-1	1	1	0	4	5	1	4	4	0	0	0	0
53. Organize and display data in table or graphs	1	0	-1	1	3	2	7	6	-1	1	1	0	0	0	0
54. Make a prediction based on the data	2	0	-2	0	2	2	4	6	2	4	2	-2	0	0	0
55. Analyze and interpret science data orally or in writing	1	0	-1	3	2	-1	2	6	4	3	2	-1	1	0	-1
56. Make a presentation to the class	2	1	-1	2	5	3	5	3	-2	1	1	0	0	0	0

Table 32: Individual teacher SEC responses regarding data collection associated with non-laboratory activities (questions 52 – 56).

0 = None
1 = Little (<10%)
2 = Some (11-25%)
3 = Moderate (26-50%)
4 = Considerable (>50%)

Positive Change in category between 2007 and 2008
Negative Change in category between 2007 and 2008
No Change in category between 2007 and 2008

	Sarah			Melissa			Christina			Heather			Angela		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
52. Have class discussions about data	3	3	0	0	1	1	3	2	-1	2	3	1	3	2	-1
53. Organize and display data in table or graphs	3	1	-2	0	1	1	2	2	0	2	2	0	2	1	-1
54. Make a prediction based on the data	3	2	-1	0	1	1	3	2	-1	2	1	-1	3	3	0
55. Analyze and interpret science data orally or in writing	3	2	-1	0	1	1	3	2	-1	1	2	1	4	3	-1
56. Make a presentation to the class	2	1	-1	0	0	0	2	2	0	0	1	1	3	1	-2

	Jessica			Tiffany			Rebecca			Michelle			Kimberly		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
52. Have class discussions about data	2	2	0	2	3	1	2	2	0	3	2	-1	1	3	2
53. Organize and display data in table or graphs	2	2	0	2	3	1	2	2	0	2	2	0	1	2	1
54. Make a prediction based on the data	2	2	0	2	3	1	2	2	0	3	2	-1	0	2	2
55. Analyze and interpret science data orally or in writing	2	2	0	2	3	1	1	1	0	3	2	-1	1	2	1
56. Make a presentation to the class	2	1	-1	2	3	1	1	1	0	2	2	0	1	2	1

Tiffany, and Melissa had increases in the amount of time that they provide for their students to organize, interpret and present data other than in laboratory settings, while Rebecca reported no change between the two administrations of the SEC and four of the teachers provided less time for these activities in 2008 than in 2007. Aligning question 31 with questions 52 – 56 seems intuitive since they address data collection in situations other than during laboratory activities. However, question 31 focuses on collection and questions 52 – 56 focus on uses of the data, which may have led to variability in the results. If question 31 on the SEC were modified to include use of the data as well as collection of data from non-laboratory activities interpretation of the results could be less problematic.

The next section of the chapter will discuss the changes the data shows about the amount of instructional activities specific to the use of technology, including computers, calculators, and other educational technologies to learn science (questions 34, and 57 - 62). As I mentioned earlier, the teachers in my study do not have equal access to the technologies covered in this section. These questions are expanded from SEC question 34 (use computers, calculators, and other educational technologies to learn science), which indicated that these teachers generally provide "little" time for their students to use technology in science. While the 2008 data indicated a slight increase in the amount of time devoted to this activity from a mean of 1.12 (SD = 0.55) in 2008, these means are an inadequate reflection of practice. Since the utilization of technology in science teaching is considered to be an activity aligned with best practice in science, more detail regarding teachers' responses to these questions is called for. Therefore I have provided individual

teacher data for both question 34, an average of each teachers' responses for the questions 57 – 62 (Table 33). The data for question 34 shows that 60% of the teachers in the

Table 33: SEC question 34 and averages for questions 57 – 62, which focus on amount of instructional time devoted to the use of technology for the learning of science.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
Q34	2007	1	1	4	2	2	2	2	2	1	2
	2008	1	1	3	0	0	2	4	1	1	2
Q57-62											
2007	*M*	1	0.2	1.7	0.7	1.2	1.3	1.8	1	1.8	0.5
	SD	0.89	0.41	0.52	1.21	0.75	0.52	0.75	0.63	1.17	0.84
2008	*M*	1.7	0.3	0.8	0.3	0.8	2.3	1.5	0.8	2.2	1
	SD	1.21	0.52	41	0.52	0.41	1.51	0.55	0.98	0.75	0.89

0 = None, 1 = Little < 10%, 2 = Some 11-25%, 3 = Moderate 26-50%, 4 = Considerable >50%

sample reported reductions in the overall time allocated to using technology in science teaching between 2007 and 2008, with two indicating that they did not use technology in 2008.

The averages for questions 57 through 62 indicate that less teaching time was spent using technology in science classes than the responses to question 34 would suggest. It is interesting to note that Tiffany indicated that she significantly increased the use of technology in her science teaching in 2008 compared to 2007. Her response shifted from two to four, or from "some" to "considerable" time devoted to teaching science with technology. However, when one looks at her average responses for questions 57 – 62, an overall decrease in her use of technology is evident. Looking at the individual questions in this section (Table 34) reveals that in some cases there is little change in responses between administrations (question 60), and in other instances the

Table 34: Distribution of SEC responses regarding use of educational technology, (questions 57 – 62).

Positive Change in number of teachers between 2007 and 2008
Negative Change in number of teachers between 2007 and 2008
No Change in number of teachers between 2007 and 2008

	None			Little (10% or less)			Some (11-25%)			Moderate (26-50%)			Considerable (50% or more)		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
57. Learn facts	1	0	-1	3	4	1	5	3	-2	1	2	1	0	1	1
58. Practice procedures	2	0	-2	3	5	2	3	2	-1	2	2	0	0	1	1
59. Use sensors and probes	7	7	0	3	1	-2	0	2	2	0	0	0	0	0	0
60. Retrieve or exchange data or information	3	3	0	5	5	0	2	2	0	0	0	0	0	0	0
61. Display and analyze data	3	2	-1	2	7	5	5	1	-4	0	0	0	0	0	0
62. solve problems using simulations	2	4	2	5	4	-1	2	1	-1	1	1	0	0	0	0

Table 35: Individual teacher SEC responses regarding use of educational technology, (questions 57 – 62).

0 = None
1 = Little (<10%)
2 = Some (11-25%)
3 = Moderate (26-50%)
4 = Considerable (>50%)

Positive Change in category between 2007 and 2008
Negative Change in category between 2007 and 2008
No Change in category between 2007 and 2008

Table 35 Continued: Individual teacher SEC responses regarding use of educational technology, (questions 57 – 62).

	Sarah			Melissa			Christina			Heather			Angela		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
57. Learn facts	1	3	2	1	1	0	1	1	0	0	1	1	2	1	-1
58. Practice procedures	1	3	2	0	1	1	2	1	-1	3	1	-2	1	1	0
59. Use sensors and probes	0	0	0	0	0	0	1	0	-1	0	0	0	0	0	0
60. Retrieve or exchange data or information	2	1	-1	0	0	0	2	1	-1	0	0	0	1	1	0
61. Display and analyze data	2	1	-1	0	0	0	2	1	-1	0	0	0	2	1	-1
62. solve problems using simulations	0	2	2	0	0	0	2	1	-1	1	0	-1	1	1	0

	Jessica			Tiffany			Rebecca			Michelle			Kimberly		
	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change	2007	2008	Change
57. Learn facts	2	4	2	2	2	0	2	2	0	3	3	0	2	2	0
58. Practice procedures	2	4	2	2	2	0	1	2	1	3	3	0	0	1	1
59. Use sensors and probes	1	1	0	1	2	1	0	0	0	0	2	2	0	0	0
60. Retrieve or exchange data or information	1	1	0	1	1	0	1	0	-1	1	2	1	0	2	2
61. Display and analyze data	1	1	0	2	1	-1	1	1	0	2	2	0	0	1	1
62. solve problems using simulations	1	3	2	3	1	-2	1	0	-1	2	1	-1	1	0	-1

change between years is obvious (question 61), with 70% reporting that they have their students use technology to display and analyze science data a "little" on the 2008 SEC. This change can be attributed to four teachers indicating that they use technology less often and one teacher who reported that her students did use technology in science in 2008, but not in 2007. When reflecting on the individual changes by teacher (Table 35, above) one can see that, with the exception of Christina who reported decreases in five of the six areas of technology use, the rest of the teachers in the sample were just as likely to report an increase as a decrease in the amount of time that they provide for their students to use technologies for various purposes in science. Jessica was the only teacher to indicate that she had any substantial increases in use of technology and no decreases. When taken as a whole, the data gleaned from both administrations of the SEC indicates that the teachers in this study generally do not use technology as part of their science teaching. Since many of the teachers have limited access to technology, this result is not unexpected.

Summary of SEC Data

The practices measured by the SEC instrument largely aligned with research and policy recommendations, such as the NSES standards for best practice in science teaching that encourage teachers to address students' initial understanding and preconceptions about science topics, provide a foundation of both conceptual understanding and factual knowledge, help the students take control of their own learning, and support collaboration among the students and with the teacher. The data provided through the two

administrations of the SEC indicate that there is little consistency between the results. This lack of consistency is reflected for the whole sample, as well as the individual teachers and suggests that the teachers in this study are just as likely to move toward a given recommended strategy as away from that strategy. Therefore using a once-a-year administration of the SEC alone does not provide enough data to establish clear trends in the opportunities teachers provide for their students and related teaching practices, if such trends exist. In order to further understand teaching practice it is essential to look beyond the SEC and to provide more points for data collection. In the next section of the chapter, analysis of responses to questions from the Weekly Teaching Survey (WTS) will be discussed.

Weekly Teaching Survey (WTS)

The WTS, (see Appendix D) contains 24 Likert style questions, with questions 1 through 8 focusing on specific teaching practice and the time allocated to each of these practices during the week. The WTS questions were adapted from the SEC and modified to reflect first person responses rather than "the teacher" and they were shortened to save time for the teachers on a weekly basis and to reflect more generalized behaviors. While some of the questions on the WTS are revised SEC questions, they use the same categories for time engaged in an instructional activity (e.g., "none", "little" (10% or less), "some" (11 -25%), "moderate" (26 – 50%) and "considerable" (50% or more)). Similar to the SEC, the WTS has expanded the questions regarding time allocated by the teachers for

laboratory activities, investigations, or experiments as well as for student work in pairs or small groups outside of the laboratory setting. The WTS also looked at teaching practice through several other lenses including a subset of questions that specifically addressed cultural integration and several questions that addressed connecting science teaching to what the students already know, their everyday lives, and their prior conceptions of the concepts. Table 36 will help the reader recognize how the questions for the WTS presented align with the SEC. Questions 1 through 5 on the WTS are similar to questions 25 – 27, 30 and 33 on the SEC. In addition to the use of revised questions, the WTS also differs from the SEC in the frequency with which teachers are asked to reflect upon their past teaching. The SEC provides one data point for the teaching year, while the WTS was given eight times during the spring of one year, and these multiple administrations will help to corroborate teacher responses on the SEC. As mentioned earlier in the chapter, the WTS is based on 80 individual surveys, with one teacher providing nine weeks of data and one teacher providing seven weeks of data.

Table 36: WTS and SEC question alignment.

WTS	1. Listen to you explain something to the whole class? 2. Read about science (not in the textbook)? 3. Work individually on science assignments? 4. Watch you do a science demonstration? 5. Take a quiz or test?
SEC	25. Listen to the teacher explain something to the class as a whole about science. 26. Read about science in books, magazines, articles (not textbooks). 27. Work individually on science assignments. 30. Watch the teacher demonstrate a scientific phenomenon. 33. Take a quiz or test.

Analyzing group responses by averaging the 400 teacher responses across the five questions has the tendency to overshadow the most salient instructional practices revealed by the data. Because of the wide variation in responses across questions and teachers, analyzing individual responses to questions was more telling. Disaggregated results by teacher for questions 1 – 5 are presented in Table 37. Results reveal that the least amount of time spent on any one activity in this group based on 80 responses for 10 teachers over eight weeks is for question 5, taking tests and quizzes with an average of .65 or less than 10% of the time. One way to represent the data is through frequency distributions for each of the questions (see Appendix G). While these individual distributions provide a high level of detail for each response, for example, Tiffany's average for question 1 (listen to you explain something to the whole class) 2.88

Table 37: Group and individual average response to WTS questions 1 – 5.

2008 WTS Responses		Q1	Q2	Q3	Q4	Q5
0 = None	Sarah	1.25	1	1.63	1	0.25
1 = Little (10% or Less)	Melissa	1.33	0.89	0.89	0.44	0.67
2 = Some (11-25%)	Christina	1.75	2.25	1.625	1	1.125
3 = Moderate (26-50%)	Heather	1.44	0.11	1.67	1	0.56
4 = Considerable (>50%)	Angela	1.56	0	1.56	0.78	0.89
	Jessica	1.63	1.38	0.5	0	1.13
	Tiffany	2.88	1.38	1.13	1.38	0.13
	Rebecca	1.86	1.71	2.43	0.29	1.29
	Michelle	4	0	3.125	2.375	0.5
	Kimberly	1.43	0.86	3.14	0.43	0
	M	1.9	0.93	1.73	0.88	0.65
	SD	0.87	0.76	0.88	0.67	0.45

indicates that she engaged in this activity more than 25% of the time but less than 50% of the time, it is important to look at the distributions in tabular form in order to understand

how the responses to each question in the section relate to each other (see Appendix H). Questions 1 – 5 are given in Table 38 and the data suggests that for roughly one third of the time, or during 26 out of 80 weeks monitored in the WTS, teachers had their students listening to the teacher explain something to the whole class. This question also had the largest mean, 1.9, indicating that on the average, when the teachers are engaged in this activity it contributes to at least 10% but less than 25% of their weekly science teaching time. The data also reveals that for almost three-fourths of the weeks the students were not quizzed or tested. However, while the data suggest that testing is not a major component of a typical teaching week, seven of the teachers reported that considerable time (50% or more) was devoted to science testing during the same week. Further analysis found that this week occurred during the period selected by the state for

Table 38: WTS Distribution questions 1 – 5 (n = 80).

	None	Little (10% or less)	Some (11-25%)	Moderate (26-50%)	Considerable (50% or more)
1. Listen to the teacher in whole class environment	10	26	18	14	12
2. Read about science in books etc (not text)	42	14	17	5	2
3. Work individually on science	21	18	17	8	16
4. Watch teacher do a science demonstration	45	17	9	4	5
5. Take a quiz or test	57	13	2	0	8

0 = None, 1 = Little (<10%), 2 = Some (11-25%), 3 = Moderate (26-50%), 4 = Considerable (>50%)

mandatory state testing as required by No Child Left Behind (NCLB) legislation. Question 2 and four have distributions similar to question 5, with large numbers of responses in the "none" category. This shows that the teachers in my sample spent little

time having students read about science outside of the textbook or watching the teachers do science demonstrations. Question 3, work individually on science assignments, had a fairly even distribution of responses with roughly three-fourths of the weeks in the study having time segments ranging from "a little" time to "considerable" time being devoted to students working alone on assignments in their science classes. Non-laboratory and laboratory items administered in separate sections on the SEC were combined on the WTS to reduce the time necessary for teachers to respond to the items collectively. For example, question 6 is a hybrid of SEC questions 29 and 33 regarding laboratory or non-

Table 39: WTS and SEC Laboratory activity, investigation, or experiment question alignment.

WTS	6. Do a laboratory or non-laboratory activity, investigation, or experiment?
	6a. students develop the questions they want to answer*
	6b. students use science equipment or measuring tools to collect data
	6c. students make observations/classifications
	6d. students make educated guesses, predictions, or hypotheses
	6e. students analyze and interpret science data
	6f. students design their own investigation or experiment
	6g. students are provided time to discuss results*
	6h. students make presentations to the class on the data/information*
	* Questions not specifically addresses in SEC Laboratory section
SEC	29 and 33. Do a laboratory activity, investigation, or experiment; Do a science activity with the class outside of the classroom or science laboratory
	39 and 40. Use science equipment of measuring tools; Collect data.
	45. Make observation/classifications.
	37. Make educated guesses, predictions, or hypotheses.
	43. Analyze and interpret science data.
	44. Design their own investigation or experiment to solve a scientific question.
	52. Have class discussions about the data.
	56. Make a presentation to the class on the data, analysis, or interpretation.

laboratory activities, investigations, or experiments that their students engage in. Teachers are asked to respond to the following statement on the WTS: please circle the types of science activities your students engaged in this week. If teachers respond "none" to question 6 (below), they skip this question and the following eight questions about specific time allocated to lab and non-lab investigative activities. Table 39 (above) presents the alignment between WTS question 6 and its sub-questions and SEC questions used to frame this section.

Results from teacher responses to WTS question 6 are reported in Table 40. This data suggests that teachers do engage their students in lab or non-lab activities, investigations, or experiments during a majority of the weeks of the study, with slightly more than 30% of the weeks falling in the "moderate" and "considerable" ranges.

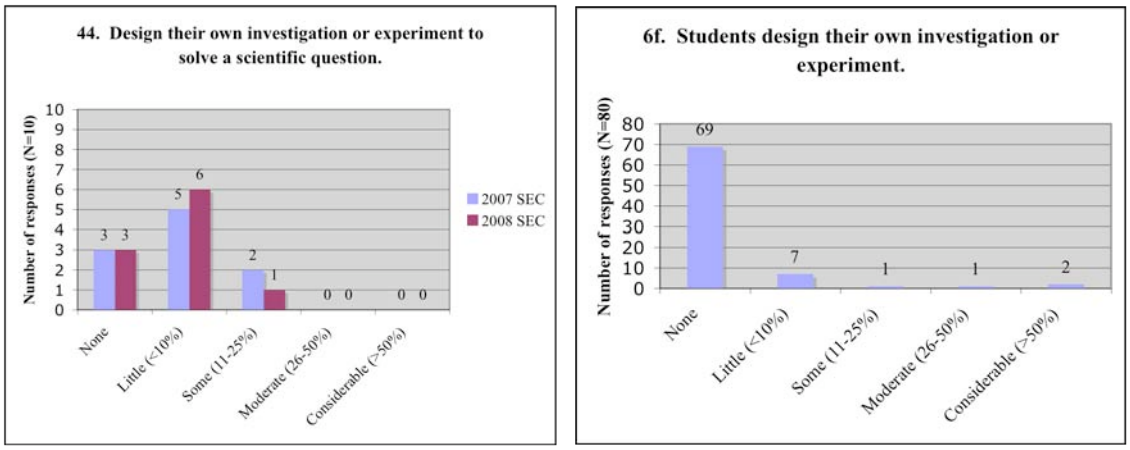
Table 40: WTS responses to questions 6, 6a – 6h (n = 80).

	None	Little (10% or less)	Some (11-25%)	Moderate (26-50%)	Considerable (50% or more)
6. Do a lab or non-lab, activity, investigation, or experiment?	26	21	8	13	12
6a. students develop the questions they want to answer	58	6	6	10	0
6b. students use science equipment or measuring tools to collect data	56	8	10	3	2
6c. students make observations/classifications	31	16	8	8	17
6d. students make educated guesses, predictions, or hypotheses	40	15	15	5	5
6e. students analyze and interpret science data	52	16	6	1	5
6f. students design their own investigation or experiment	69	7	1	1	2
6g. students are provided time to discuss results	39	10	18	5	8
6h. students make presentation to the class on the data/information	70	7	3	0	0

0 = None, 1 = Little (<10%), 2 = Some (11-25%), 3 = Moderate (26-50%), 4 = Considerable (>50%)

While the teachers report that they are engaging their students in laboratories at times, the common activities tend to be making observation/classifications, discussing results, and making educated guesses, predictions, or hypotheses. This table also reveals that the least amount of time spent on activities while teaching science in laboratory or non-laboratory type settings involved students designing their own investigations or experiments or making presentations to the class on the data/information collected during lab or non-lab activities, investigations or experiments. Results reported in Table 42 indicated that teachers allocate very little time to these activities, which is similar to the SEC results, yet the WTS indicates that even less time is being devoted to these activities than does the SEC. For example responses for SEC question 44, when compared to responses for WTS question 6f (see Figure 13), shows that when reflecting back on the entire year, half of the teachers indicate that they do devote "a little" time to students designing their own

Figure 13: Comparison of results between SEC question 44 and WTS question 6f.



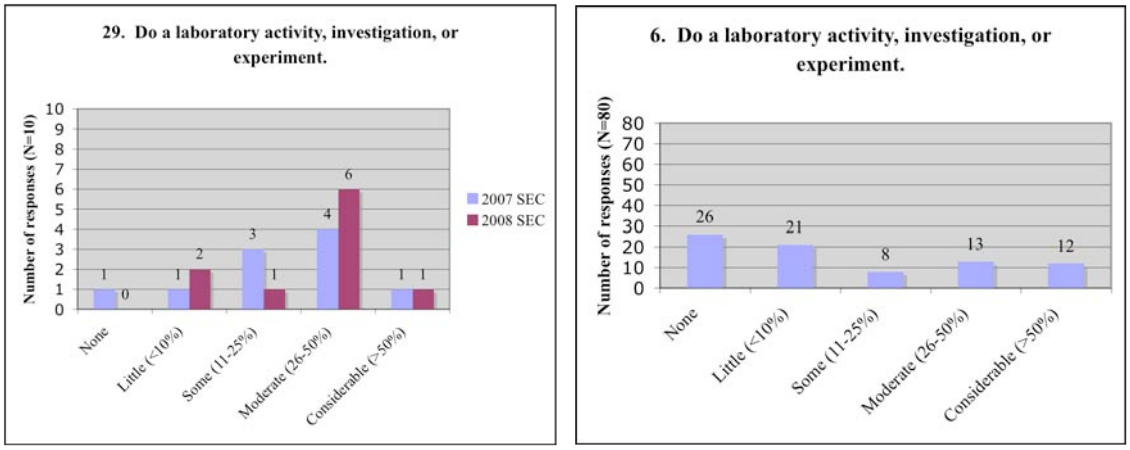
questions or experiments. Yet, teachers responding to the WTS indicated no time was devoted to student designed investigations or experiments during the vast majority of

weeks monitored. If such investigations are distributed across the year, rather than concentrated during certain periods, then the SEC results may be inflated regarding student designed investigations. The eight weekly administrations of the WTS suggest that it is a more stable indicator of actual teaching practice than the once a year, retrospective SEC. The WTS also reveals that during the study there were only 12 instances where the teachers devoted 50% or more of their science teaching time to laboratory or non-laboratory activities, investigations, or experiments, and 47 instances where they spent 10% or less of their teaching time engaging students in these activities (see Appendix I). Individual data shows that Kimberly never had her students engaged in laboratory or non-laboratory activities during the study, and Jessica had her students participate in these activities for only half of the weeks. It important to note that Kimberly is a special education teacher and that Jessica is a Reading Specialist. Specialists generally do not teach science and may have unique data that is not representative of the time the typical elementary teacher spends delivering science instruction. However, they are included since each of these teachers attempts, as part of their commitment to BSSP and to graduate studies in science education that they are pursuing, to regularly include science in her curriculum.

The difference in the frequency, with which the WTS and SEC are administered, and the reliance on teacher recollection of events in the distant past may account for some differences between the responses for similar questions. Differences in frequency of administrations for both instruments may be one explanation for the difference between the results of SEC question 29 and WTS question 6 (see Figure 14). Data from SEC

question 29 indicates that six of the teachers have their students engage in laboratory activities for "moderate" amounts of time during the school year and in 2008 none of the teachers indicated that they engaged in such activities. There appears to be a tendency for the teachers' responses on the SEC to regress toward the middle, indicating some use or moderate use of particular practices, while their responses on the WTS were more likely to fall at the ends of the continuum. Therefore responses to WTS question 6 appear to contradict the SEC results with roughly a third of the responses indicating that no laboratory or non-laboratory activities were being provided by teachers during those weeks. It is important to again note that only one teacher responded "None" for all eight weeks of the study and her data does not necessarily represent a typical teacher in this study. Further analysis of the distributions of responses by the individual teachers to

Figure 14: Comparison of results between SEC question 29 and WTS question 6.



WTS question 6 indicated that eight of the 10 teachers in the study had their students engage in laboratory or non-laboratory activities for a "Moderate" amount of time during at least one week of the study.

While the SEC results and the WTS results both indicate that a majority of the teachers in the study did engage their students in laboratory and non-laboratory investigative activities occasionally, the WTS allowed for a more detailed look at one eight-week period during the spring of 2008. The WTS results show that the time devoted to lab and non-lab investigations is far more minimal than indicated by the SEC findings. Overall, results suggest that teachers are providing time for their students to engage in laboratory and non-laboratory activities, investigations, and experiments. The data also suggests that the activities the teachers are providing for the students reflect alignment to the recommendation of the NSES and other groups. For example, they provide standards-aligned practices such as, making time for students to observe, classify, make predictions and discuss results appear in the data. However, the results indicate that overall such opportunities happen just occasionally, and that relatively few opportunities are provided for students to experience investigative science.

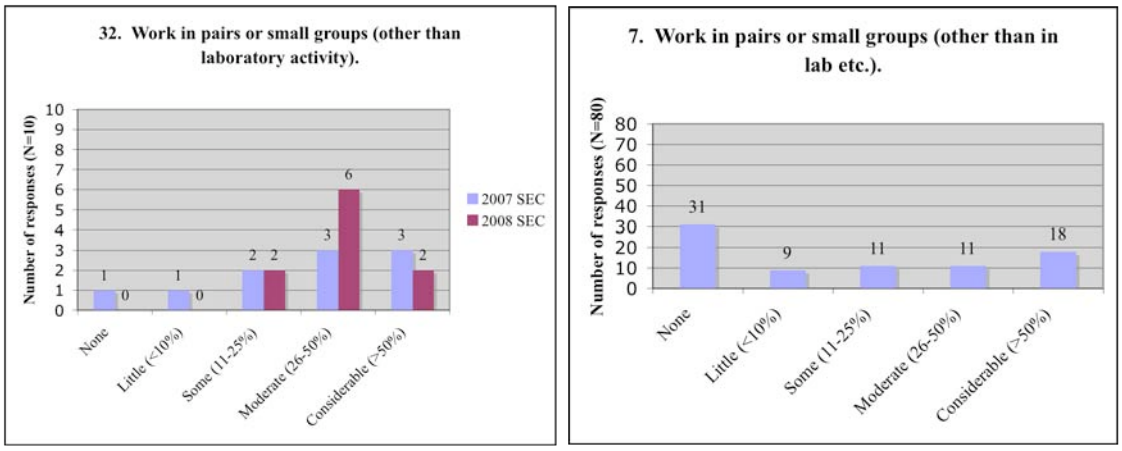
One of the activities that received the greatest amount of investigative science teaching time was discussion of results by students, a form of collaboration. Teacher responses to WTS question 7 were found to be similar to those for SEC question 32. Table 41 shows how questions 7a through 7e align with SEC questions 46 – 49 and 51. Teacher responses to WTS Question 7 indicated that the average amount of time devoted to pair and group work was 1.73 (SD = 1.64), or between "little" and "some." This is less than the mean of 2.6 (SD = 1.35) or between "some" and "moderate," in the 2007 SEC and much less that the mean of 3.0 (SD = 0.67) or "moderate" in the 2008 SEC results (see Figure 15). At first glance the responses to WTS question 7 appear to contradict

Table 41: WTS and SEC instructional time in pair and small groups (other than lab).

WTS	7. Work in pairs or small groups - other than in lab?
	7a. complete written assignments from text/workbook
	7b. review assignments or prepare for quiz or test
	7c. students talk about ways to solve science problems
	7d. write-up results or prepare presentation
	7e. work on an assignment, report, or project (1 week +)
	7f. explain science concepts to other members of the group*
	* Questions not specifically addressed in SEC pairs or small groups section
SEC	32. Work in pairs or small groups (other than in laboratory activities).
	47. Complete written assignments from textbook or workbook.
	51. Review assignments or prepare for a quiz or test.
	46. Talk about ways to solve science problems, such as investigations.
	48. Write-up results or prepare presentation from a laboratory, activity, investigation, experiment or research project.
	49. Work on an assignment, report or project over an extended period of time.

SEC results with pair and small group work not used during 31 of the weeks monitored. Yet it is important to recognize is that when teachers provided time for students to

Figure 15: Comparison of results between SEC question 32 and WTS question 7.



collaborate, in 29 of the weekly responses, they were providing "moderate" or "considerable" amounts of time, which mirrors the SEC results, particularly from 2008.

Distribution of responses to the seven questions on collaborative work in Table 42, provide a more detailed description of teachers' responses. This table reveals that the least amount of time is spent on reviewing assignments or preparing for quizzes or tests (question 7b). The collaborative activity that garners the greatest amount of time is working on an assignment, report or project together for more than one week (7e). Questions 7d and 7a have distributions similar to question 7b, indicating that the majority of the teachers in my sample devote little to no time to these tasks on a weekly basis.

Table 42: Whole group response distribution to WTS questions 7, 7a – 7f, (n = 80).

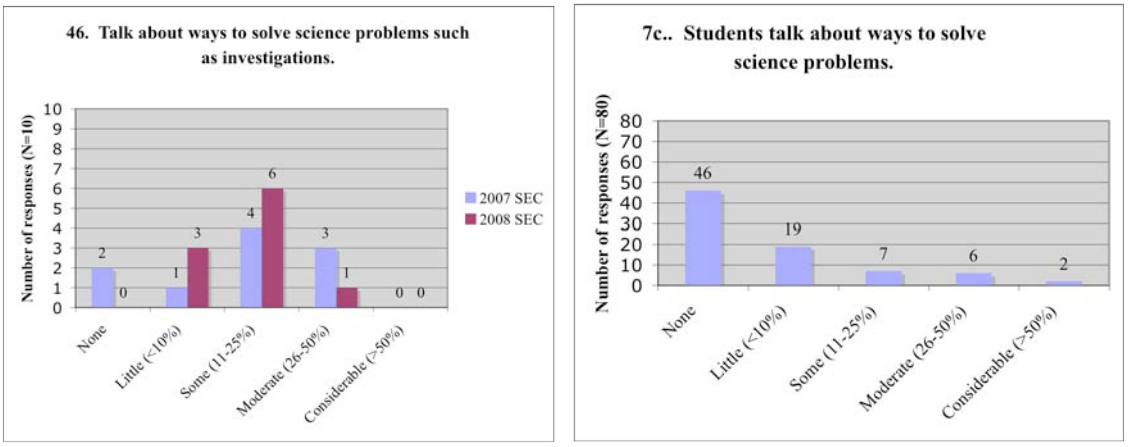
	None	Little (10% or less)	Some (11-25%)	Moderate (26-50%)	Considerable (50% or more)
7. Work in pairs or small groups - other than in lab etc.?	31	9	11	11	18
7a. complete written assignments from text/workbook	57	10	5	5	3
7 b. review assignments or prepare for quiz or test	61	11	3	3	2
7c. students talk about ways to solve science problems	46	19	7	6	2
7d. write-up results or prepare presentation	56	13	6	1	4
7e. work on an assignment, report, or project (1 week +)	46	12	10	5	7
7f. explain science concepts to other members of the group	44	21	9	6	0

0 = None, 1 = Little (<10%), 2 = Some (11-25%), 3 = Moderate (26-50%), 4 = Considerable (>50%)

The WTS results indicate that the students infrequently engaged in activities involving reviewing assignments, completing written assignments from their text, or preparing for presentations during their pair and small group time, (7a, 7b, 7d). However, the data does indicate that students are collaborating verbally. Questions 7c and 7f focus on verbal interaction and refer to the amount of time provided for students to talk about ways to

solve science problems or explain science concepts to each other. Results from these two questions are very similar and show that for roughly a quarter of the weeks students were engaged in these activities for "a little" time and for 12 of the possible weeks monitored students were engaged for longer periods of time. Question 7c (see Figure 16) is similar to SEC question 46 and Figure 16 provides a comparison of the results of these similarly worded questions.

Figure 16: Comparison of results between SEC question 46 and WTS question 7c.



This section of the WTS reveals that during the eight weeks of the study the teachers provided the students opportunities to work collaboratively in pairs or small groups during approximately 60% or 48 of the 80 possible science teaching sessions. The majority of these opportunities involved verbal interaction as students talked about ways to solve science problems or explained science concepts to each other. Collaborative forms of learning, like those in this section of the WTS, are aligned with Native American ways of learning.

The next series of questions on the WTS, eight through twelve, Table 43, have been

included to further describe the practices occurring during science teaching. Question 8 is similar to SEC question 28, "Write about science in a report/paper on science", and responses for both instruments (see Figure 17) indicate that few opportunities for this activity are being provided to the students. It is interesting to note that there was a shift to less time for this activity reported on the 2008 SEC compared to 2007, and this shift is

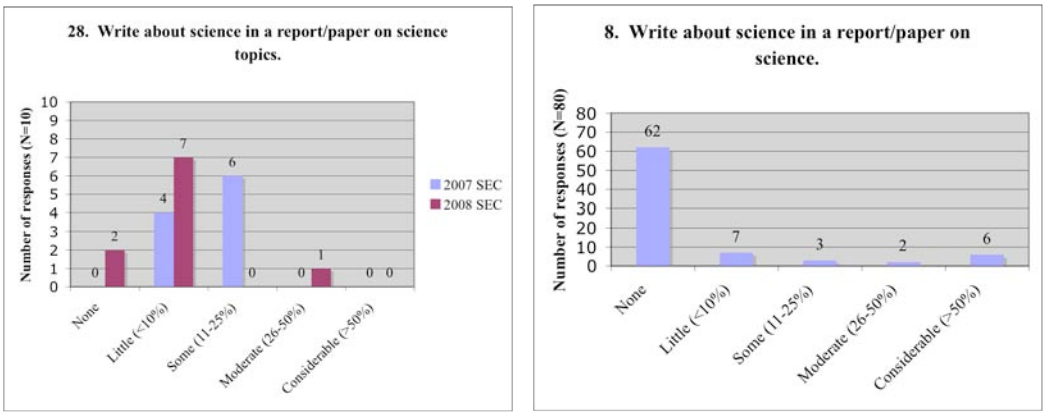
Table 43: Whole group response distribution to WTS questions 8 through 12, (n = 80).

	None	Little (10% or less)	Some (11-25%)	Moderate (26-50%)	Considerable (50% or more)
8. Write about science in a report/paper on science?	62	7	3	2	6
9. Work at their own pace?	13	13	22	8	24
10. Participate in discussions to further science understanding?	14	21	24	11	10
11. Participate in activities they generate, organize, or direct?	43	21	8	6	12
12. Plan and participate in community-based learning activities?	66	9	3	1	1

0 = None, 1 = Little (<10%), 2 = Some (11-25%), 3 = Moderate (26-50%), 4 = Considerable (>50%)

consistent with the WTS, with "none" reported for slightly over 77% (72/80) of the weeks in the study for this activity. Responses to Question 9, "Work at their own pace," and question 10, "Participate in discussions to further science understanding," revealed that the teachers in my sample generally provide time during science for these activities. Both of these activities had the highest average responses on the WTS and the fewest "none" responses. Providing time for students to discuss and to work at their own pace are both strategies that provide for students' own sense-making. Questions 11, "Participate in activities they generate, organize, or direct," and 12, "Plan and participate in community-based learning activities" were included in the WTS to uncover the degree to which students initiate and lead the science activities they are participating in. The

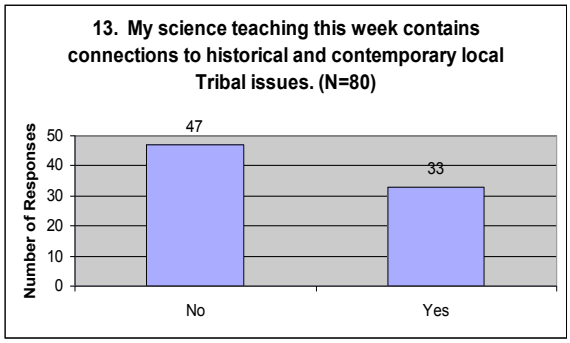
Figure 17: Comparison of results between SEC question 28 and WTS question 8.



data for question 11 indicates that during almost half of the science sessions students spent at least "a little" time participating in activities that they developed. The data for question 12 reveals that during the eight weeks of the study little, if any science teaching time was devoted to community-based science activities.

WTS question 13 asked the teachers to respond yes or no to the following, "My science teaching contains connections to historical and contemporary local Tribal issues." If the teacher responds yes, she is then asked to respond to four sub-questions. This question is included on the WTS because the teachers in my sample teach at schools where the majority of students are Native American and to help provide data for research question 2b, "Is the teaching responsive to local Tribal culture and contexts?" The responses to question 13 (Figure 18) indicated that roughly 59% (47/80) weeks of science instruction mentioned during the study had no link to local Tribal issues. Individual teacher responses for question 13 reported in Table 44 show that there is a considerable distribution of responses with Melissa and Christina responding that they included local

Figure 18: WTS Question 13.



Tribal issues during only one week of the study, and Tiffany and Rebecca including local Tribal issues in 60 weeks or 75% of the time. It is interesting to note that one teacher,

Table 44: Matrix of teacher responses to WTS question 13

	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
Yes (1)	5	1	1	3	6	4	6	6	0	2
No (0)	3	7	7	5	3	4	2	2	8	5
M	0.63	0.13	0.13	0.38	0.67	0.5	0.75	0.75	0	0.29
SD	0.517	0.353	0.353	0.517	0.5	0.534	0.462	0.462	0	0.487

Michelle, a Native American, indicated that she did not include local Tribal issues during the eight weeks of the study. For those weeks when the teacher responded yes, sub-questions 13a through 13d (see Table 45) were provided to further clarify what aspects of local Tribal issues were generally included. These questions have been adapted from similar questions on the Cultural Inclusion Survey (CIS) (see Appendix D) and use three Likert scale response choices: "Not at all," "To some extent," and "To a great extent" to rate the extent of inclusion for each activity or action. Since the initial choice for the lead question to this section only provided a yes or no choice, I have decided to graphically

Table 45: WTS sub-questions for positive response to Question 13 compared with similar questions from Cultural Inclusion Survey (CIS) instrument.

WTS	13a. I include traditional stories from local cultures in my teaching.
	13b. I include science content about contemporary local issues.
	13c. I include historical content about local cultures in science.
	13d. I include Tribal members or elders as a cultural resource.
CIS	151. Traditional stories from local Tribes
	152. Content about contemporary local Tribal issues.
	153. Historical content about local American Indian Tribes.
	155. Visit by a Tribal member to your class to share cultural information.

represent the data for the 33 instances (weeks) for which the teachers responded yes. Based on these responses (see Table 46), when the teachers include current or historical local Tribal issues, roughly 60% of the time (20 of 33 weeks) they respond "to some extent" to the sub-questions. The data also reveals that when the teachers do include Tribal issues, they very rarely include Tribal members or elders as part of the science lessons being taught.

Table 46: WTS Response distribution for questions 13a – 13d based on positive responses to question 13 (n = 33)

Frequency Distribution based on "Yes" Responses N = 33	Not at All	To some extent	To a great extent
13a. I include traditional stories from local cultures in my teaching.	11	19	3
13b. I include science content about contemporary local issues.	8	22	2
13c. I include historical content about local cultures in science.	10	21	2
13d. I include Tribal members or elders as a cultural resource.	25	7	1

Questions 14 through 17 (see Table 47) look at the extent to which the teachers align their teaching to miscellaneous other practices recommended in the National Science

Education Standards (NSES). Question 18 (see Table 47) directly asks the teachers to

Table 47: WTS questions 14 through 18.

WTS	14. I connect my science teaching to what students' already know.
	15. I integrate my science teaching into other subjects.
	16. I integrate students' everyday life into my science teaching.
	17. I integrate students' prior conceptions into my science teaching.
	18. I integrate science standards into my teaching.
	0 = Not at All, 1 = To some extent, 2 = To a great extent

report on the extent of integration of science standards into their teaching. Questions 14 – 18, use the same three Likert scale response choices used to collect teacher responses for question 13.

The responses for question 14 (see Table 48) indicate that during the eight weeks of the study the teachers connected their teaching to what students already knew "to some extent" half of the time (40 of 80 weeks) and "to a great extent" in 26 weeks or over 30% of the time. The responses to questions 15 through 17 are very similar to question 14 with the teachers responding that they integrated their teaching into the everyday lives of their students "to some extent" for 47 of the 80 weeks, almost 60% of the time, and

Table 48: WTS Response distribution for questions 14 -18.

Distribution based on *n*= 80	Not at All	To some extent	To a great extent
14. I connect my science teaching to what students already know	14	40	26
15. I integrate my science teaching into other subjects.	14	42	24
16. I integrate students' everyday life into my science teaching.	17	47	16
17. I integrate students' prior conceptions into my science teaching.	15	41	24
18. I integrate science standards into my teaching.	17	34	29

[a] Note, one teacher left this question blank so this question $N = 79$

"to a great extent" 20% of the time (16/80 weeks). The last question in this section (question 18) asks to what extent teachers felt that they were integrating science standards into their teaching. During the 80 weeks monitored the teachers only indicated "Not at all" 17 times, or roughly 21% (17/80 weeks) of the time. The results indicate that the teachers feel that they are integrating science standards "to some extent" almost 43% of the time (34/80 weeks) and "to a great extent" 36% of the time (29/80 weeks).

Overall, the data from the WTS indicates that the teachers in this study allocate more of their science teaching time for laboratory or non-laboratory investigative activities that use collaborative instructional strategies. This result suggests that teachers are using their time to provide instruction that is aligned with best practice in science (NSES, 1996). Results further indicate that students generally made observation/classifications or discussed results for 54 occasions when engaged for at least "a little" time, in various laboratory and non-laboratory activities, investigations, or experiments. The teachers also provided more time for the students to make educated guesses, predictions or hypotheses than they did for them to analyze and interpret science data, design their own experiments, or make presentations about the data to the class. The teachers in the study report that 50% (40/80 weeks) of the time they have their students engaged for at least "a little" of the time making educated guesses, predictions or hypotheses. The data also indicates that when not engaged in lab and non-lab investigative activities or pair and small group work the students are listening to the teacher lecture, working individually on science assignments, or reading about science.

Results of the WTS small group work subsection show that when the teacher provides time for pair and small group collaboration, the activity most commonly reported is providing time for students to discuss ways to solve science problems, followed by students explaining science concepts to other members of the group. One interesting finding from the pair and group work subsection is that during 34 of the weekly reports, teachers provided time for students to engage in long-term assignments. Beyond these two subsections, the WTS reveals that most of the time the teachers allow their students to work at their own pace and provide them opportunities to participate in discussions to further develop scientific understanding. Unfortunately not much time is allocated for participation in activities the students generate or in community-based learning. A moderate amount of time, 27% (22/80 weeks) is devoted to making connection to local Tribal issues. The teachers apparently felt confident enough to lead this instruction themselves since very few involved Tribal members or elders as cultural resources even though many schools in this region employ elders as cultural consultants.

The WTS suggests that the teachers believe that they are integrating state and national science standards into their teaching "to some extent" or more almost 80% of the time. They also report that they integrate science into other subjects, connect their science teaching to what students already know, integrate the students' everyday life into their teaching and integrate students' prior conceptions roughly 80% of the time. The responses indicate these teachers are striving to meet the standards.

Classroom Observation Protocol (COP)

In the spring of 2008, teachers participating in this study, along with the other teachers in the BSSP, were observed during their teaching by qualified raters using Horizon's Classroom Observation Protocol (COP) (see Appendix C). This instrument was designed to measure effective instruction and has been used in the past with middle school teachers who work on or near the two Native American Indian Reservations in this study. Woolbaugh (2004) used this instrument with 13 teachers to observe a total of 68 lessons. Based on Woolbaugh's (2004) work with these teachers and his extensive

Table 49: Woolbaugh's Five Factors from the COP aligned with recommended practices for Native American Learners.

Factor one – "Minds-on Science"
C6. Intellectual rigor, constructive criticism, and challenging of ideas was evident.
I1. The instruction was consistent with underlying approach of the instructional materials as outlined in the standards.
I2. The instructional strategies were consistent with investigative science.
L6. Science is portrayed as a dynamic body of knowledge enriched by investigative analysis.
L8. Appropriate connections were made to other areas of science and to real world contexts.
L9. The degree of "sense-making" of science content was appropriate for the developmental needs of learners.
Factor two –"Lesson Design"
D1. The design of the lesson incorporated tasks, roles and interactions consistent with investigative science.
D3. The instructional strategies and activities used reflected attention to students' preparation.
D10. Design for future instruction takes into account what transpired in the lesson.
Factor three –"Lesson Implementation"
C5. The climate of the lesson encouraged students to generate ideas, questions and/or propositions.
I4. The teacher's management style enhanced the lesson.
I6. The teacher was able to "read" the students' level of understanding.
I7. The questioning strategies were likely to enhance the development of student understanding.
I8. The lesson was modified as needed based on teacher questioning.
D8. Adequate time and structure were provided for wrap-up.
D7. Adequate time and structure were provided for "sense-making."

Table 49 Continued: Woolbaugh's Five Factors from the COP aligned with recommended practices for Native American Learners.

Factor four - "Student / Teacher relationships"
C1. Active participation of all was encouraged and valued.
C2. There was a climate of respect for students' ideas, questions, and contributions.
C4. Interactions reflected collaborative working relationships between teacher and students.
Factor five – "Cooperative Learning"
C3. Interactions reflected collegial working relationships among students.
D5. The instructional strategies and activities reflected attention to issues, equity, and diversity for students.
D6. The design of the lesson encouraged a collaborative approach to learning.

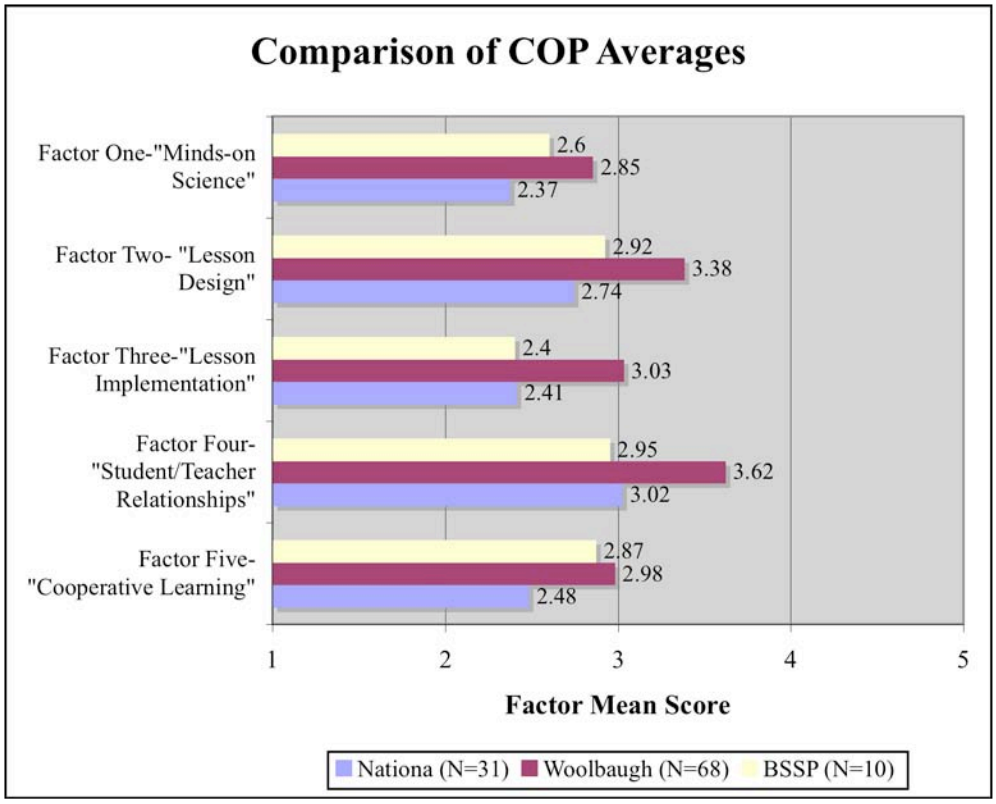
Note: C = Classroom Culture Category, D = Design Category, I = Implementation Category, L = Content Category

review of the literature, he found that 24 of the 33 items on the instrument aligned with recommended teaching practices for Native American students. Woolbaugh (2004) analyzed these items using exploratory factor analysis to identify the underlying dimensions represented by the COP instrument. Results from his analysis found a five-factor solution representing five subscales presented in Table 49 (above) (Woolbaugh 2004). Evidence for the unidimensionality of each subscale is based on reported coefficient alphas, which ranged from .70 to .94. When Woolbaugh had completed analysis of his participants' COP results he used COP data from a national sample of teachers at 31 sites as a reference for comparison. The average subset scores (see Figure 19) of the teachers in this study were compared to the average scores in both Woolbaugh's sample and to the national study. This analysis was undertaken to better understand how teachers' practices, investigated by this research, compares to other teachers both nationally and on the two Native American reservations of interest to my

research.

Subsection averages for teachers in this study were very similar to the mean subsection scores in national sample data. However, when compared to Woolbaugh's averages, BSSP teacher average subsection scores were generally lower. Results from subsection comparisons to Woolbaugh's and a national sample, indicate that the teachers

Figure 19: Comparison of Factor Mean Score for BSSP research sample, Woolbaugh's (2004) sample, and national sample.



1 = Not at all, 3 = To some extent, 5 = To a great extent

investigated in this study scored lowest on the Lesson Implementation subsection. Disaggregating the data by item for this subsection reveals that the teachers, as a group are

able to "read" the students' level of understanding "To some extent" for item I6 (M = 3.20, SD = 1.48), and they all exhibit good classroom management skills (item I4) "To some extent" (M = 2.71, SD = 1.70). On the other hand they scored lower at providing time and structure for "sense-making", item D7 (M = 1.86, SD = 1.21), which falls closer to "Not at all" than "To some extent". Additionally, three other items in this subsection earned low scores. Average scores, falling between "Not at all" and "To some extent" indicated that the teachers could improve how they wrap-up the lesson, item D8 (M = 2.00, SD = 1.26); modify the lesson based on their questioning, item I8 (M = 2.00, SD = 0.82); and provide lessons that encourage students to generate ideas, questions and/or propositions, item C5 (M = 2.43, SD = 1.51). It is interesting to note that while the teachers in this study had the same areas of weakness as the teachers in Woolbaugh's study, they rated much higher than the national sample at their ability to "read" their students. The means for each of the items within the five factors are presented in Appendix H.

The "Minds-on Science" subsection involves six items pertaining to the degree to which understanding of science concepts and the nature of science are fostered through instruction observed during the lesson. This factor had the second lowest overall factor mean at 2.60 (SD = 0.35), yet the mean, was higher than the national COP mean of 2.37 for the same factor. This finding suggests that teachers engaged in these activities "To some extent" and are generally engaged at a higher level than when compared to teachers

from the national sample. The teachers were rated highest on item I1 (M = 3.0, SD = 1.77) and item I2 (M = 2.86, SD = 1.07), indicating that their instructional activities are consistent with state and national standards as well as investigative science. These scores were found to be slightly higher than the averages found for the teachers in Woolbaugh's study. However, the scores for the four additional items in this factor are still low and indicate areas that could use improvement.

The second highest overall mean (2.92, SD = 0.20) was for the "Lesson Design" subsection which had three items. The results for item D1 (M = 3.14, SD = 1.07) indicates, in this study, like those investigated by Woolbaugh's research, design lessons are more consistent with investigative science than the teachers in the national sample. The next two items, D3 (M = 2.86, SD = 1.35) and D10 (M = 2.75, SD = 1.26) were lower than the means in Woolbaugh's research and indicate that BSSP teachers, while engaged in these practices "To some extent", could improve their lesson design by doing more to design future lessons that take into account what happened during the lesson observed.

The student/teacher relationship subsection was found to have the highest overall mean (M = 2.95, SD = 0.08). This subsection contained three items from the classroom culture portion of the COP. The teachers in this study had higher scores for item C1 (M = 3.00, SD = 1.41) and item C4 (M = 3.00, SD = 1.55) indicating that they had a good working relationship with students and valued and encouraged active participation of all students. Item C2, which measured the climate of respect for students' ideas, questions,

and contributions, had a mean of 2.86 (*SD* = 1.46), which was slightly lower than the other items ratings. However, when the low score for C2 is removed from those used to determine factor mean for student/teacher relationships, it becomes 3.06, which closely matches the national sample (*M* = 3.02).

The "Cooperative Learning" subsection had an overall mean rating of 2.87 (*SD* = 0.39), which was higher than the mean for the national sample and slightly lower than the mean for the teachers in Woolbaugh's study. While the mean for this subsection was higher than the national sample, it was lower than anticipated based on the teacher reported data from the WTS that indicated that the teachers used "pair and small group" instruction during about 60% of the available teaching opportunities. The weakest item rating for this factor was item D6 (*M* = 2.43, *SD* = 1.27), which suggests that while the teachers stated that they engage their students in collaborative learning, the design of the lessons observed did not involve collaboration that centered on building understanding of science concepts. One observer commented:

> Teacher seemed used to and allowed student interaction during activity. However, did not "use" this as an opportunity to teach.

Comments like this taken from the COP and the low rating for this item indicate that pair and small group collaboration could be improved and that lessons could be designed that leverage student interaction to help students work together toward the goal of learning science concepts.

The results of the COP using Woolbaugh's five COP subsections indicates

that these teachers design lessons that incorporate tasks, roles and interactions consistent with investigative science, that are consistent with instructional approaches and materials outlined in the state and national science standards, and that they encourage active participation of all students in these lessons. The data also indicates that while the teachers often use collaborative teaching techniques and the students display a high level of comfort with each other; they could leverage this camaraderie to help students work together toward the goal of learning science concepts. Additionally, results found that while the teachers "know" their students and can "read" their level of understanding, they need to provide more time and structure for wrap-up and "sense-making" during the lessons. Results from teacher COP ratings indicate that, on average, this group of teachers exhibit more standards-based teaching practices when compared to the national sample on three of the five subsections. There was little difference when compared to the average national COP ratings for the Lesson Implementation and for student/teacher relationships.

Scoop Notebook

Teachers were introduced to the Scoop Notebook (Borko, Stecher, and Kuffner, 2007) and asked to "scoop" materials from three related science lessons all focused on a single topic or theme, as well as provide pre, mid, and post reflections, describing their decision-making and perspectives on the lessons. The Scoop Notebook includes a calendar in which the teachers describe the activities the students engaged in, as well as

the amount of time devoted to the lessons, and the curriculum materials that were used. Teachers also submitted student work samples, photos, and other documentation of the lessons.

It is important to note that the "scoop" was taken during science lessons that were being done to meet requirements of participation in the BSSP and may not reflect a typical week in the teacher's classroom. With this in mind, photos accompanying the Scoop Notebook overwhelmingly show the students engaged in pair and small group activities. These activities are often in the classroom (8 of 10) with the students working at their desks or tables. In two of the Scoop Notebooks, the images show the students working collaboratively outside of the classroom. In one case, the students are outside measuring how heat affects air and in the other students are working together in the hallway making measurements. One set of images shows the students engaged with a Tribal elder as they learn a Native American legend about a well known geological formation.

Based on the Scoop Notebook calendar, all ten teachers participating in this study used laboratory activities, and engaged students in reading from worksheets or from text or other resources. Just over two-thirds (7/10) of the teachers involved students in science activities that required them to make predictions, observations, or record results. Four teachers promoted discussions focused on results of science investigations, and three used instructional activities that resulted in student engagement in model building. The teachers describe these activities in the calendar in short statements:

> Taking temperature of different land surfaces; grassy, sidewalk, and gravel… Students predict, observe, and record results. Students make bar graph of results. (Michelle)
>
> Group lab: read the description of the rock in the book, observe the real rock from the collection and discuss. (Sarah)

In addition to these short statements in which the teachers describe what activities the students were engaged, the Scoop Notebook has three opportunities for the teachers to reflect on the lessons. The post Scoop reflection is of the most interest to my research since it asks the teachers to reflect back on the lessons they presented during the Scoop and to comment on how representative of typical instruction these lessons were with respect to content, instructional strategies, and student activities. In general, the teachers comment that their schedule makes it very difficult to have science every day for a week or more. Michelle commented, "I have tried really hard to get science in every week," and that the requirements of the Scoop made it necessary for her to move social studies to another week. Another teacher, Heather commented that while it is unusual to have science everyday of the week, she usually spends part of her "lessons on hands-on and part on reading." Comments by Tiffany summarize the general theme of all the comments found within the reflections in the Scoops,

> I do think that this series of lessons had more time and planning than which is typical for science at this grade level. However, it was mutually rewarding for students and myself. I would like to make this the norm in the future.

In general, reflections and comments within the Scoop Notebook and calendar reveal that much of the science involved reading about science topics enhanced by hands-

on activities that primarily focused on observation and classification. Another activity that was found in many of the Scoops was model building related to the study of earth landforms (e.g., volcanoes, stream features, crystal shapes, and plate tectonics). The Scoop Notebooks also reveal that the science instruction during the period of the Scoop data collection period was unusual only in the amount of time spent on activities related to science. Data was not collected specific to instructional strategies, science content, or type of science activities. Results from teacher comments and photographic images confirm, that students worked much of the time in pairs and small groups when engaged in science activities. However, there was little evidence from the Scoop Notebooks to determine the influence these collaborative hands-on activities had on building student knowledge about the concepts being explored. The information provided by the Scoop Notebooks supports results from the SEC, COP, and WTS indicating that science instruction for the teachers in this study is best characterized as collaborative and focused on observation and classification.

Interviews

As stated earlier in this chapter, shortly after the conclusion of the first year of the BSSP, the teachers in my sample were interviewed to better understand their schools and teaching situations. Examples follow of responses to questions that asked the teachers to reflect and describe the characteristics of science instruction occurring in their classrooms: "How would a typical science lesson look in your classroom?"

> …my students learn science best by doing science, and a lot of modeling. If the teacher demonstrates first, and shows them, then that's what helps them. Or even just talking about it. Or you know, their prior experience, if one already knows how to do it then use them, and you know have the
>
> other groups use him as a helper…. So, those are the things that have worked for me. (Rebecca)
>
> I know they talk about one on one…(pauses), not one on one, hands-on. But I think you have to incorporate that plus… a lot more. (Jessica)
> A lot more what? (RMJ)
> A lot more. I think you need to incorporate the reading part of it. You also need to incorporate group activities, and discussion. (Jessica)
>
> I think they learn science best the same way that everybody does, with hands-on type materials. Now, that does not necessarily mean that they are getting a perfect understanding of it. But at least they are engaged and being engaged is something (laughs). They might not necessarily understand exactly what we're trying to get them to understand but, like I said, it, they are getting something. And, I guess that is all that really matters, that we get something. (Melissa)
>
> Cooperative groups and hands-on, those are the two big things. Cuz I have a lot of, a lot of high kids and a lot of low kids so they kind of helped each other out. (Angela)
>
> Hands-on…(pauses), they would be asking each other questions and talking about it, maybe drawing a picture of it or maybe acting it out. (Heather)

The interview responses reflect a theme that was common for all the teachers in this study, that the teachers believe that hands-on activities are one of the best ways to teach science concepts, but need to be accompanied by other types of experiences that address every students' way of knowing. A second major theme found in eight of the ten interviews was a focus on various forms of cooperative learning. While two of the teachers didn't specifically refer to cooperative learning activities when asked to think

about what their teaching looks like, they did refer to cooperative learning situations in responses to other questions during the interview.

Summary Of How The Teachers Are Using Their Science Teaching Time

Taken collectively the data from the SEC, the WTS, the COP, the Scoop Notebook, and interviews indicate that when the teachers in my sample teach science they typically have their students work in pairs or small groups engaged in laboratory or non-laboratory activities, investigations, or experiments that focus on observation and classification. The students also spend considerable time listening to the teacher explain something to the whole group and reading about science. Reading is a constant and was especially cited in the interview responses. When engaged in lab and non-lab science investigations the results showed that the students are often following step-by-step directions, making observations and classifications, and organizing and displaying data in graphs or tables. One other component of inquiry, making educated guesses, predictions, or hypotheses is cited as occurring relatively frequently, i.e. during 25% or more of the time allocated for science.

While the SEC and WTS imply that the teachers could do more in certain areas to make their teaching more aligned to the standards, the COP indicate that this group of teachers, on average, exhibit more standards-based teaching practice than a national sample in three out of five areas of related practices identified by Woolbaugh (2004). The COP results also indicated that the teachers in the sample have practice that is essentially the same as teachers in the national sample in a fourth area, lesson implementation.

The teachers' comments both in the interviews and the self reflections in the Scoop Notebooks indicate that they value hands-on cooperative activities as one of the best ways that their students learn and that they use this method frequently. The data from the COP, WTS, and SEC support this. It is also important to note that seven of the ten teachers in the sample indicated that they devote moderate to considerable amounts of their science teaching time to pair and small group activities, which has been recognized as being a component of culturally responsive pedagogy. The teachers in my study often use laboratory and non-laboratory activities in their teaching that encourage collaborative interaction among students. However, observers noted that the teachers could leverage the high level of comfort and camaraderie observed among the students toward the goal of learning science concepts, and that the teachers need to provide more time and structure for wrap-up and "sense-making" during the lessons. The next section of this paper will focus on the influences that drive both the time teachers devote to science, as well as the content and delivery of the science.

What Influences Teachers' Decisions about How They Teach Science

In the previous sections of this chapter the discussion focused on what the data revealed about the amount of time that the teachers in my sample were devoting to the teaching of science and what that teaching looked like. These data indicated that the teachers are teaching science, generally on a weekly basis, averaging between 0.6 and 1.9 hours and that they generally have their students working on laboratory and non-laboratory activities in pairs and small groups. The following section of this chapter will

look at what the various data sources can tell us regarding the influences that drive teachers' decisions about how much time they teach science and how that teaching looks. Similar to the preceding sections of this chapter, the research question will be addressed through the data gathered with each of the instruments.

Surveys of Enacted Curriculum

The SEC was given twice, once prior to participation in the BSSP in June 2007 and shortly after the conclusion of year one in June 2008. The data from both administrations will be discussed, with attention given to responses relevant to the research question on the influences that the teachers perceive affect the amount of time they devote to science teaching, and their science teaching practice. The SEC includes a ten question subsection (questions 71 – 80) that specifically addresses instructional influences. Teachers were asked to indicate the degree to which each item influences what they teach in their science classes. For purposes of this research, seven of the ten items (Table 50) that relate most directly to the research questions posed for this study were selected.

Table 50: SEC Instructional Influences questions investigated in this study.

71. Your state's curriculum framework or content standards.
72. Your district's curriculum framework or guidelines.
73. Textbook/instructional materials.
74. State tests or results.
75. District tests or results.
76. National science education standards.
79. Parents/community.

For each of these items teachers are asked to indicate the type and degree of

influence with Likert choices including: "Not Applicable," "Strong Negative Influence," "Somewhat Negative Influence," "Little or No Influence," "Somewhat Positive Influence," "Strong Positive Influence." The teachers in this study selected the "Not Applicable" option infrequently suggesting that most of teachers felt that these factors have an influence on what they teach. However, Kimberly responded "Not Applicable" to all items regarding influences on teaching in 2007, and thus her data was not included in the group average for that year. For calculation of the mean and standard deviations the "Not Applicable" responses were excluded for both years, and other responses were entered using a five point scale with ratings greater than three indicating a positive influence on teaching. Looking at this subgroup of items for both 2007 (M = 3.54; SD = 0.56) and 2008 (M = 3.98; SD = 0.44) and averaging the responses of all the teachers in my sample across these items suggests that the teachers feel that these influences, when taken together, have a slightly positive influence on what they teach. These averages do not take into account individual variation among teachers, and therefore I have disaggregated the data by teacher (Table 51), which shows that the range in averages for

Table 51: Average response to SEC questions 71 – 76 and 79, disaggregated by teacher.

		Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly
2007	*M*	3.57	2.57	3.29	3.5	3.29	3.43	4.57	4.14	3.5	X
	SD	0.54	1.13	0.76	1.41	0.76	0.53	0.79	0.38	2.08	X
2008	*M*	4.14	3.71	3.57	3.29	4	4.57	4.71	4.14	4	3.67
	SD	0.38	0.49	0.53	0.76	2,14	0.49	0.53	0.69	1.51	1.57

1 = Strong Negative Influence, 2 = Somewhat Negative Influence, 3 = Little or No Influence, 4 = Somewhat Positive Influence, 5 = Strong Positive Influence

this cluster of items varies from 2.57 for Melissa to 4.71 for Jessica. When looking at the other nine teachers in the sample, the reader can see that they generally reported that the influences were more positive in 2008 than in 2007. Heather was the only teacher whose average rating of the influences decreased slightly in 2008. To understand how these teachers rated these instructional influences I have provided frequency distributions for each of the questions, giving data for both 2007 and 2008 in Figure 20 and Appendix F.

The average responses for all of the questions in this subsection changed in a positive direction from 2007 to 2008, suggesting that each influence was seen as more beneficial to the teachers' practice in 2008. The responses to question 73 (below), showed the greatest change with eight of ten teachers reporting that their textbooks

Figure 20: SEC questions 71 through 76 and 79 from both 2007 and 2008, (n = 10).

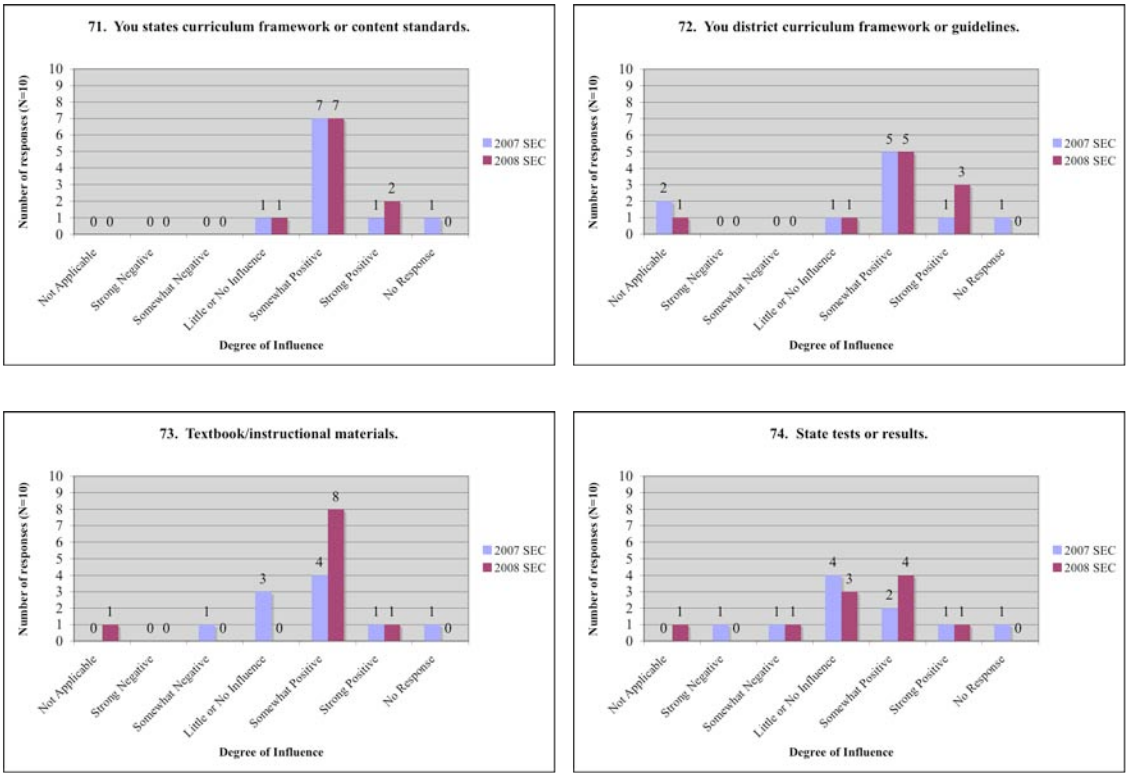
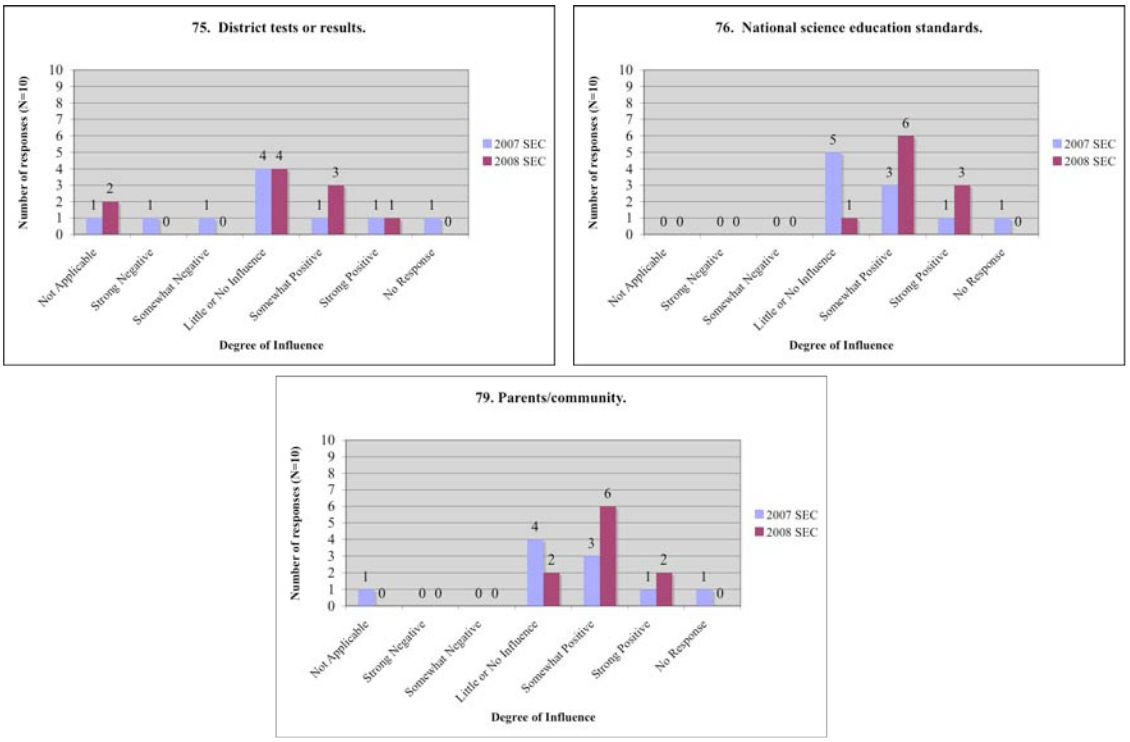


Figure 20 Continued: SEC questions 71 through 76 and 79 from both 2007 and 2008, (n = 10).



and/or instructional materials had a "Somewhat Positive Influence" on what and how they teach science in 2008 compared to four teachers in 2007. The teachers in my sample also reported a slight but noticeable change from 2007 to 2008 when reporting the influence of state tests or results on their teaching (question 74), with two more teachers indicating that these mandated tests have had a "Somewhat Positive Influence" on their science teaching. This may be related to the fact that Montana began to measure science performance on state tests in the spring of 2008.

When taken as a whole, the data from both administrations of the SEC indicates that the teachers in my study generally considered the items within the Instructional Influences subsection as having a somewhat positive influence on what science content

they teach and how they teach it. Two teachers responded in the "Somewhat Positive Influence" to "Strongly Positive Influence" range in 2007, and this had increased to four teachers in 2008. In addition, for both years there were six teachers responding in the "Little or No Influence" to "Somewhat Positive Influence" range.

In summary, by 2008 eight of the teachers felt that these influences as a whole had at least a slightly positive influence on their teaching. This is evident in the average ratings for this item cluster that range from 3.29 to 4.71 and exceed the neutral choice of 3.0. One teacher, Rebecca, had no change in her average rating between the two administrations of the SEC with an average both years of 4.14 indicating that she found these influences to have a "Somewhat Positive Influence" on her teaching. Only one of the ten teachers had a decrease in her average rating in 2008. This decrease, from 3.50 in 2007 to 3.29 in 2008, was small and her average rating remained in the "Little or No Influence" to "Somewhat Positive Influence" range. Although it is not possible to pinpoint the precise reasons for the shift toward more positive responses regarding influences on teaching for the eight teachers exhibiting this shift between the two SEC data sets, it is plausible, that factors such as participation in BSSP professional development, the start of state wide testing in science, or increased level of access to instructional materials for science teaching caused these shifts in a short time.

Weekly Teaching Survey (WTS)

Teachers agreed to provide eight weekly teaching surveys that asked them to

reflect back on their science teaching for the previous week. This instrument (see Appendix D) contains 24 Likert style questions, with questions 19 through 24 focusing on instructional influences during the week of the survey. Question 25 asks the teachers to write a short reflection on one or more of the factors that had the greatest influence on the science they taught during the previous week and how they taught the science. The response scale for these questions was adapted from the SEC and uses two different Likert scales to assess teachers' perceptions of science teaching practice. The first scale for each question has three prompts, designed to measure the extent of the influence on the respondent's teaching including "Not at all", "To some extent", and "To a great extent." The second set of prompts, were borrowed from the SEC and measure the positive, negative, or neutral nature of the influence. The Likert prompts for the second scale include: "Strongly Negative", "Somewhat Negative", "Little or No Influence", "Somewhat Positive", and "Strongly Positive." Since the first set of prompts has the "Not at all" option, I made a decision in my design to leave the "Not Applicable" option off of the second set of response choices. Table 52 shows how questions 19 – 24 align to the SEC questions. The WTS questions, like the SEC questions use the following prompt: indicate the degree to which each of the following influences what you teach in the target science class.

To understand how the WTS responses compare to those for the SEC we will look at the second set of prompts for this cluster of questions first. These prompts pertain

to the positive, negative, or neutral nature of an influence on the respondent's science teaching.

Averaging the responses to the second prompts across all influences produces a mean of 3.63 (*SD* = 0.59), which falls between the responses to the comparison items

Table 52: WTS and SEC Instructional Influences question alignment.

WTS	19. The parents/community influences what and how I teach.	SEC	79. Indicate the degree that Parents/community influence your science teaching.
	20. State tests or results influence what and how I teach.		74. Indicate the degree that state tests or results influence your science teaching.
	21. State curriculum framework or standards influence what and how I teach.		71. Indicate the degree that Your state's curriculum framework or content standards influence your science teaching.
	22. District curriculum framework or standards influence what and how I teach.		72. Indicate the degree that Your district's curriculum framework or guidelines influence your science teaching.
	23. The textbook and/or curriculum materials selected by the district influence what and how I teach.		73. Indicate the degree that Textbook / instructional materials influence your science teaching.
	24. District level tests or results influence what and how I teach.		75. Indicate the degree that District tests or results influence your science teaching.

from the 2007 (*M* = 3.54; *SD* = 0.56) and the 2008 (*M* = 3.98; *SD* = 0.44) SEC. It is interesting to note that the mean and standard deviation for these responses on WTS were closer to those of the 2007 SEC even though the teachers completed the 2008 SEC only a few weeks after the sampling window for the WTS. Table 53 shows the range of individual teacher averages and the group average for responses to the second set of prompts in this section. This data reveals that there is some variation between the teachers in their responses, as indicated by the range of means and standard deviations.

Yet, all of the means, which range from 3.36 to 4.36, are on the positive side of the neutral

Table 53: Average response to WTS questions 19b through 24b, disaggregated by teacher and giving overall mean and standard deviation for the sample (N=10).

	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly	Sample
M	3.78	3.57	3.5	3.52	3.63	3.48	4.36	3.36	3.67	3.52	3.63
SD	0.421	0.17	0.21	0.22	0.49	0.16	0.09	0.25	0.42	0.36	0.59

1 Strongly Negative, 2 Somewhat Negative, 3 Little or No Influence, 4 Somewhat Positive, 5 = Strongly Positive

choice of 3.0. Table 54 disaggregates the responses to the second set of prompts by item and teacher. This table reveals that Parents/Community (M = 3.44, SD = 0.42) and district level tests and results (M = 3.47, SD = 0.36) were perceived by the teachers as having the least positive influence on their instructional practice. Frequency distributions

Table 54: Group and individual average response to WTS questions 19b – 24b (n = 80).

	Sarah	Melissa	Christine	Heather	Angela	All (*M*)	All (*SD*)
19. The parents/community influences what and how I teach.	3.13	3.33	3.25	3.67	2.78	3.44	0.42
20. State tests or results influence what and how I teach.	3.88	3.78	3.75	3.44	4.00	3.69	0.27
21. State curriculum framework or standards influence what and how I teach.	4.13	3.67	3.63	3.67	4.00	3.79	0.32
22. District curriculum framework or standards influence what and how I teach.	4.13	3.56	3.50	3.22	4.00	3.72	0.37
23. The textbook and/or curriculum materials selected by the district influence what and how I teach.	3.38	3.67	3.63	3.78	3.67	3.64	0.48
24. District level tests or results influence what and how I teach.	4.00	3.44	3.25	3.33	3.33	3.47	0.36

1 Strongly Negative, 2 Somewhat Negative, 3 Little or No Influence, 4 Somewhat Positive, 5 = Strongly Positive

Table 54 Continued: Group and individual average response to WTS questions 19b – 24b (n =80).

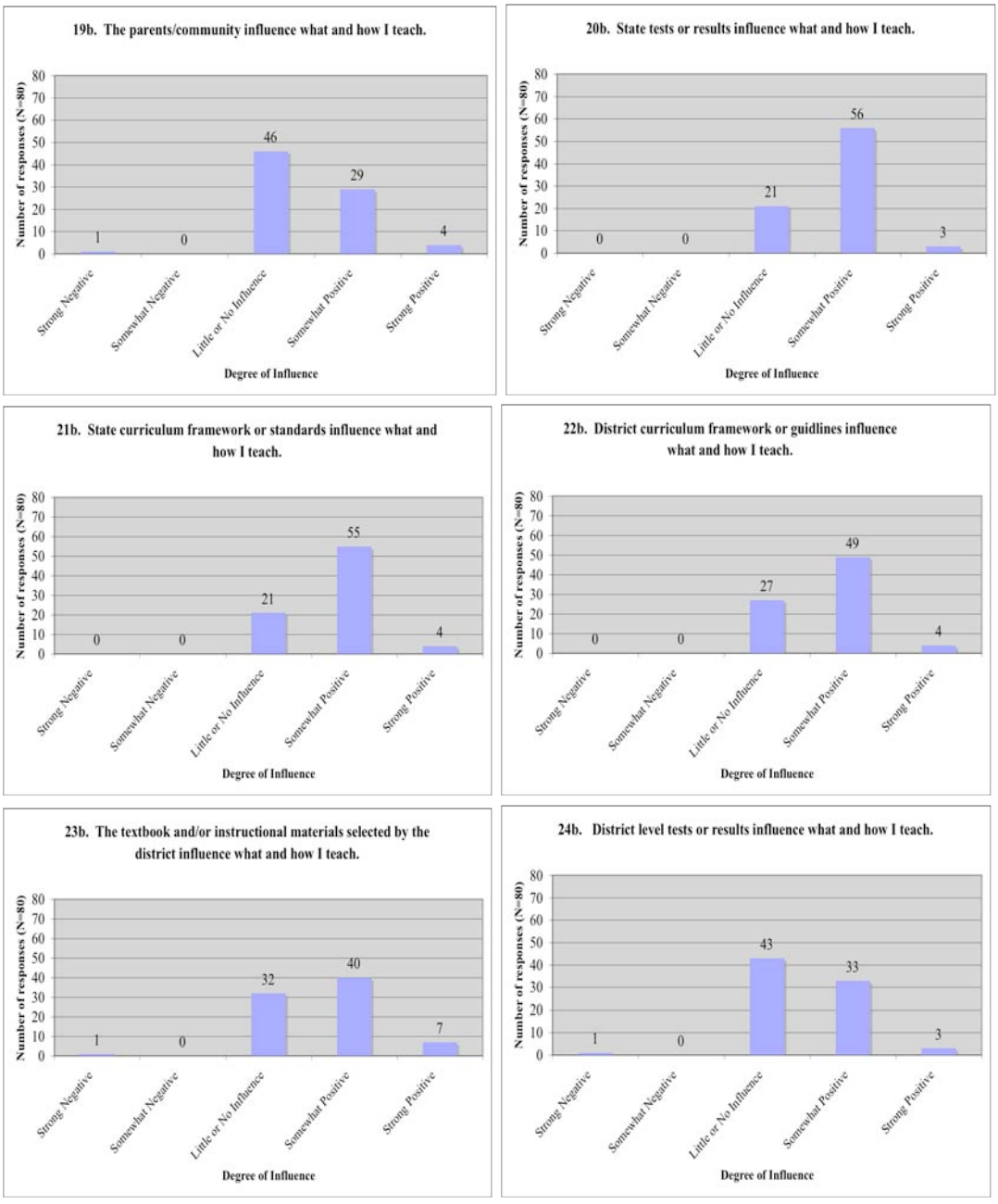
	Jessica	Tiffany	Rebecca	Michelle	Kimberly	All (M)	All (SD)
19. The parents/community influences what and how I teach.	3.50	4.38	3.29	3.63	3.43	3.44	0.42
20. State tests or results influence what and how I teach.	3.50	3.35	3.29	3.88	4.00	3.69	0.27
21. State curriculum framework or standards influence what and how I teach.	3.25	4.38	3.57	3.88	3.71	3.79	0.32
22. District curriculum framework or standards influence what and how I teach.	3.75	4.38	3.71	3.25	3.71	3.72	0.37
23. The textbook and/or curriculum materials selected by the district influence what and how I teach.	3.50	4.50	3.00	4.25	3.00	3.64	0.48
24. District level tests or results influence what and how I teach.	3.38	4.25	3.29	3.13	3.29	3.47	0.36

1 Strongly Negative, 2 Somewhat Negative, 3 Little or No Influence, 4 Somewhat Positive, 5 = Strongly Positive

for each question (see Figure 21 and Appendix G) are provided to show the most common perceptions for these teachers across the six instructional influences assessed. Questions 21b, State curriculum framework or standards (M = 3.79, SD = 0.32) and question 22b, District curriculum framework or standards (M = 3.72, SD = 0.37) had the highest overall means, with both questions falling closer to the "Somewhat positive" choice than for the other four questions. The responses to the second set of prompts for these two questions (Figure 21) indicate that state and district curriculum and standards are perceived as having the most positive influence on what and how the teachers in this sample teach.

Results from the WTS indicates that all of the influences listed have some positive effect on what and how the teachers in my sample teach as perceived by the

Figure 21: Frequency distributions of responses to WTS questions 19b - 24b (n = 80).



teachers. It is also important to also determine the extent of the influence on the weekly teaching practice of these teachers. The first set of prompts to WTS questions 19 through 24 were specifically focused on how these influences impact weekly teaching practice. These prompts allow teachers to select whether an influence affects their practice "Not at all", "To some extent", or "To a great extent". The mean for all responses to the first set of prompts is .903 (*SD* = 0.69), which indicates that the teachers perceive these influences as affecting their teaching "To some extent". Table 55 disaggregates the data by teacher

Table 55: Average response to WTS questions 19a through 24a, disaggregated by teacher and giving overall mean and standard deviation for the sample (*n* = 80).

	Sarah	Melissa	Christina	Heather	Angela	Jessica	Tiffany	Rebecca	Michelle	Kimberly	Sample
M	1.15	0.648	0.788	0.758	0.741	0.920	1.61	0.998	0.854	0.620	0.903
SD	0.291	0.609	0.764	0.738	0.149	0.706	0.454	0.403	0.213	0.352	0.693

0 = Not at all, 1 = To some extent, 2 = To a great extent

and shows the range of teachers' perceptions regarding the extent to which the influences as a whole affect their teaching. This data reveals that there is considerable variation between the teachers' responses to the first set of prompts averaged by teacher across all the questions in this cluster. Mean responses were found to range from 0.62 to 1.61 on a three-point scale. Table 56 is provided to show teachers' responses to questions 19a through 24a disaggregated by item and teacher. It is interesting to note that Kimberly (*M* = 0.62, *SD* = 0.35) and Rebecca (*M* = 0.99, *SD* = 0.40) both responded that textbooks and/or instructional materials selected by the district had no influence on their teaching

during the eight weeks of the WTS. Additionally, results from Angela's (M = 0.74) items found that parents/community had no influence on her teaching during the eight weeks of the WTS. This table reveals that the teachers perceive district level test and results (question 24a, M = 0.61, SD = 0.39) as having the least influence on what and how the teachers teach followed by parents and the community (question 19a, M = 0.74, SD = 0.53). The frequency distributions for these questions can be found in Figure 22 and Appendix G. Interestingly, in the next section of the survey regarding the degree of each influence, it was found that just over 50% (41/80) of the teacher surveys reported that district level tests and results and parents/community influence instructional activities

Table 56: Group and individual average response to WTS questions 19a – 24a (n = 80).

	Sarah	Melissa	Christine	Heather	Angela	All (M)	All (SD)
19. The parents/community influences what and how I teach.	0.50	0.33	0.50	1.00	0.00	0.74	0.53
20. State tests or results influence what and how I teach.	1.00	0.89	0.88	0.67	1.00	0.99	0.27
21. State curriculum framework or standards influence what and how I teach.	1.25	0.67	1.00	0.89	1.00	1.10	0.36
22. District curriculum framework or standards influence what and how I teach.	2.00	0.56	0.75	0.44	1.00	1.05	0.61
23. The textbook and/or curriculum materials selected by the district influence what and how I teach.	1.00	1.00	1.35	1.11	0.89	0.96	0.60
24. District level tests or results influence what and how I teach.	1.13	0.44	0.25	0.44	0.56	0.61	0.39

Table 58 Continued: Group and individual average response to WTS questions 19a – 24a (n = 80).

	Jessica	Tiffany	Rebecca	Michelle	Kimberly	All (M)	All (SD)
19. The parents/community influences what and how I teach.	0.75	2.00	0.71	0.75	0.86	0.74	0.53
20. State tests or results influence what and how I teach.	1.13	1.63	0.71	1.00	1.00	0.99	0.27
21. State curriculum framework or standards influence what and how I teach.	0.88	1.75	1.71	1.00	0.86	1.10	0.36
22. District curriculum framework or standards influence what and how I teach.	1.25	1.63	1.86	0.25	0.71	1.05	0.61
23. The textbook and/or curriculum materials selected by the district influence what and how I teach.	0.88	1.38	0.00	2.00	0.00	0.96	0.60
24. District level tests or results influence what and how I teach.	0.63	1.25	1.00	0.13	0.29	0.61	0.39

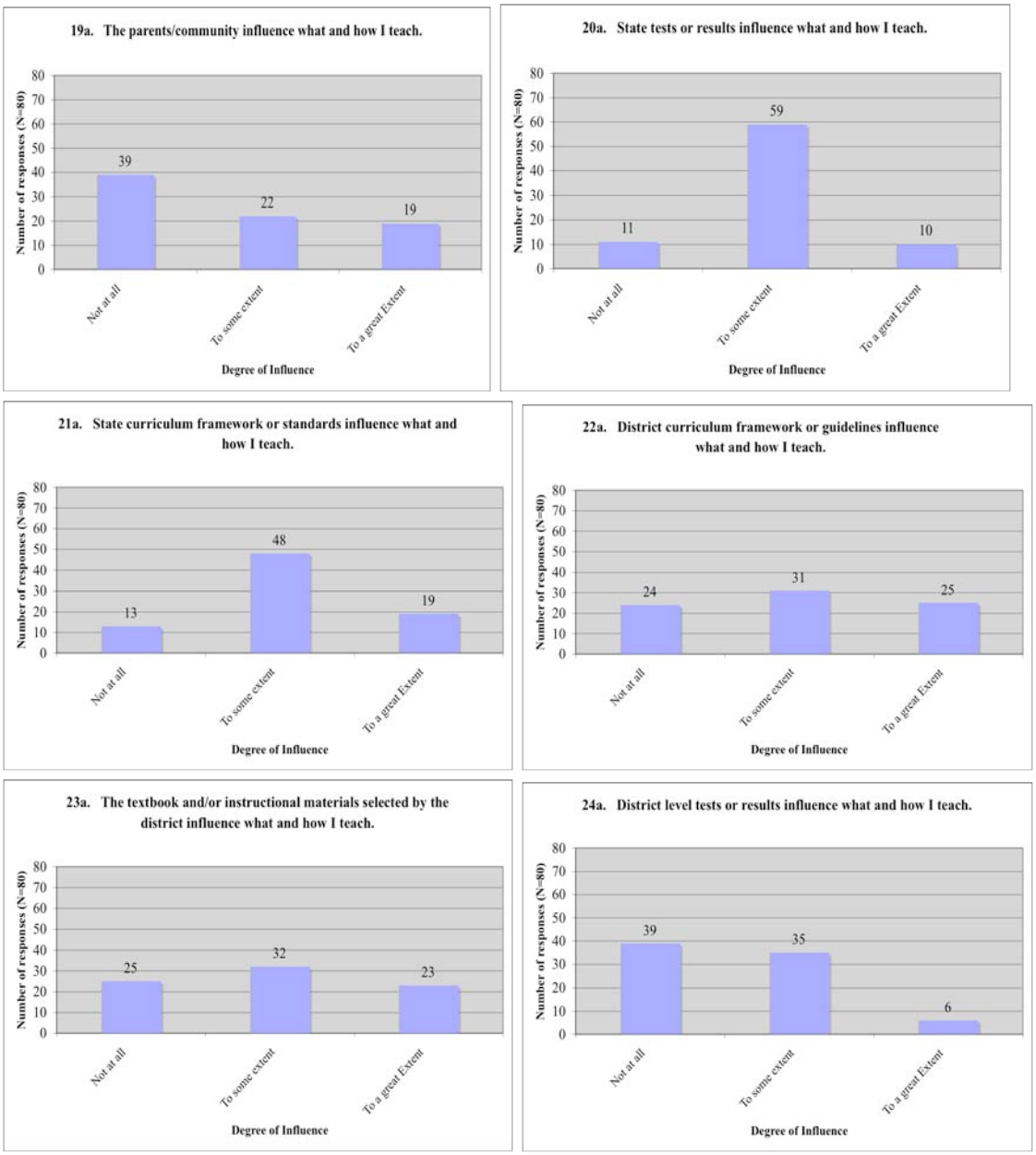
0 = Not at all, 1 = To some extent, 2 = To a great extent
Weeks that had only "Not at all" responses are indicated in light green.

"To some extent" or "To a great extent". For question 19a the responses indicating that the parents or community had an influence were distributed with roughly 54% of the remaining responses (22/41) falling in the "To some extent" category and about 46% (19/41) in the "To a great extent" category, suggesting that during weeks when parents/community had an influence close to half of the time it is to a great extent. Question 24a had the lowest number of responses in the "To a great extent" category of any of the influence choices 6/80 (7.5%), which indicates that district tests and results rarely have a "great" influence on what the teachers in my sample teach or how they teach, even though some influence is present more than half the time (41/80 weeks

monitored).

Question 21a, regarding state curriculum framework or standards influence on practice (M = 1.10, SD = 0.36) and question 22a, on the influence of District curriculum

Figure 22: Frequency distributions of WTS questions 19a through 24a, (n = 80).



framework or guidelines (M = 1.05, SD = 0.61) had the highest overall means, falling

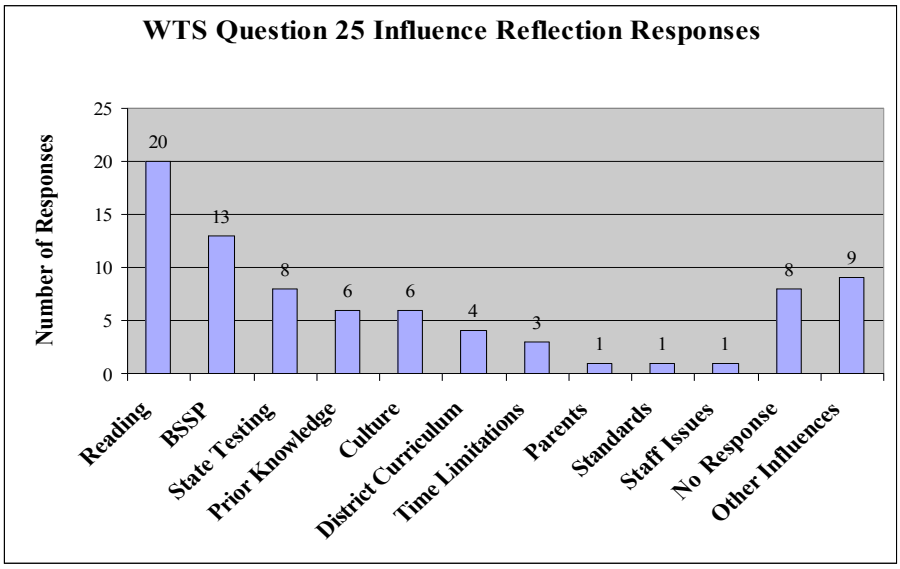
slightly beyond the "To some extent" option in each instance. The responses to these two questions indicate that state and district curriculum and standards are the factors most likely to have at least some influence on instructional strategies and science content of the BSSP teachers in my sample. While question 22a has a higher mean score than four of the other possible influences on practice, the reader should note that for 24/80 (30%) of the possible response opportunities during the eight weeks of the survey the teachers indicated that district curriculum or standards had no influence on their teaching. Explaining the distributions of the responses for the other questions reveals that question 20a, state tests or results influence what and how I teach (figure 19, above), had the lowest rate of "Not at all" responses with 11/80 (13.8%) and the highest number of "To some extent" responses with 59/80 (73.8%). This indicates that while the teachers generally do not feel that state tests or results influence their teaching "To a great extent" each week, they do feel that state tests or results have some influence on what they teach and how they teach roughly three-fourths of the time. Both parts of questions 19 through 24 on the WTS indicate that the teachers feel that state and district curriculum frameworks or standards have an influence on what they teach and how they teach, and state tests or results affect their teaching during more weeks monitored (59/80) than any other influence measured in the WTS. While the teachers reported earlier that parents and the community (question 19) and district tests or results (question 24) often had "little or no influence on teaching practice," interestingly they also reported in more than half the surveys (41/80) that the level of influence for each of these factors was "to some extent"

or "to a great extent". Furthermore, roughly half the time when a parent/community influence was reported it was rated as affecting teaching "to a great extent".

WTS Reflection Question

In addition to the Likert style survey questions on the WTS, question 25 asks the teachers to reflect on one or more factors that had the greatest influence on their teaching over the past week. The following section of this chapter will look at these responses. Many of the teachers responded to question 25 (Figure 23) each week with comments that ranged from only a few words; for example, Melissa's comment that, "We were testing so I didn't teach science this week," to much longer responses that focused on a

Figure 23: Distribution of Responses to WTS Reflection Question 25 (n = 80).



variety of influences. The responses to this question followed several themes that resonate as influences for the teachers in the sample. I have attempted to select the dominant themes (Figure 23 above) based on the most common responses. Twenty

responses focused on the influence of teaching reading on what the teachers teach. Comments such as Jessica's, "Everything is correlated to our reading materials," Rebecca's comment, "Science this week focused on reading vocabulary," and what Tiffany said, "We read two of Arnold Lobel's stories about Frog and Toad in our 90 minute reading block," were fairly common reflection posts. Following reading as the most common theme was the influence of the teachers' participation in the Big Sky Science Partnership (BSSP) professional development program that they have been part of for the past year. Comments included:

> Because of the lack of resources I used what I learned in the BSSP courses to develop this unit. (Rebecca)
>
> The BSSP class has had a great influence on what I am teaching in science this year. I have used a lot of materials from books that I was given by them. They have been a great help. (Melissa)
>
> BSSP influenced my teaching because I was finishing my Scoop. (Heather)
>
> We also created concepts maps on what students know about rocks. This is going to be our next unit because it is of interest to the students, it's in the science curriculum, and I am working with this in BSSP classes. (Angela)

Angela's comment also tied to two other themes that resonated for many of the teachers in my study: uncovering students' prior knowledge and district curriculum as being factors that often influence science teaching. Reflections that focused on ties to students' prior knowledge included:

> We then sat in a circle on the floor and each child had several turns telling about creatures which live around us (in our community). (Tiffany)

> I really try hard to bring in what students already know about rocks in this area by what they observe. Then, I moved them into how those are used in everyday things that they don't know about. (Sarah)
>
> What my students already know always has some influence on what and how I teach. However, if I only taught things they have some knowledge about I wouldn't be teaching much science. (Melissa)
>
> What students know and what they wondered about will help to design lessons for the fossils unit. I found that some of the questions they asked were the same questions I came up with when developing the unit. The challenge is to integrate cultural knowledge into the unit. (Rebecca)

Rebecca's reflection tied students' prior knowledge to her difficulty in integrating culture into science teaching. Culture like the themes of reading, BSSP participation, and ties to students' previous knowledge resonated through many (six) of the comments on instructional influences. In addition to Rebecca's comment, related statements included:

> The cultural element was present when we discussed rocks that were good sweat rocks and rocks that made good arrowheads (Kimberly)
>
> I worked really hard on trying to bring in more culture to our study of rocks this week, but I was unable to find someone to come to my room. (Sarah)
>
> Our culture teacher, …checked with some community resources for us to determine which frogs reside in our (community) area. (Tiffany)

In addition to these major themes, state testing and preparation for these tests was commented on eight times as influencing science teaching plans with responses including:

> MontCas testing this week. (Christina)
>
> The only science we did this week was in taking the CRT on Science as mandated. (Angela)

> We are not a public school although we do have our students take CRT's. The test results help me plan for teaching my future science classes (Michelle)
>
> We were testing so I didn't teach science this week. (Melissa)

The remaining reflection comments were scattered across influences ranging from parents, to staff issues, to science standards:

> As I am writing I can see how parents do influence my teaching science. Our school started a recycling club and I was surprised on how my parents signed permissions slips to have their child join. This was a teachable moment for me because we had just covered taking care of our natural resources as such the metal resource. (Michelle)
>
> I have had some problems with school counselor. She decided that she knew more about what was best for a student than me. She thought he should choose. I said I would take care of it so I would continue to teach science and the scientific process at the same time. I believe in choice, I also believe in teaching skills in a genuine situation. We as a staff need to work together for thebenefit of students. I guess my point is there is lots on interference when it comes to some students. (Christina)
>
> I need to know the state standards more so as to incorporate them into my lessons. I know I am teaching standards, but I want to understand and know that I am teaching this standard with a particular lesson I am teaching. (Michelle)

Each of the teachers had at least one specific reference to the lack of time for science and the influence of the district curriculum, especially reading, on their practice. It is interesting to note that, according to Michelle, science is the first subject to go "whenever our schedules get interrupted."

These reflections reveal that the major influences on teaching practice for the teachers in my sample are reading and their participation in the BSSP, followed by state tests and test preparation as a distant third most common influence. The influence of the students' prior knowledge and integration of culture into the content both were mentioned

six times by the teachers and have some influence on practice. It is interesting to look back at WTS question 20a, "State tests or results influence what and how I teach" (Figure 22) and to see that the responses to this question and the comments found in the reflection question support each other. The influences of the district curriculum framework or standards, (WTS question 22) was not cited as a major influence in the reflection comments. However, district curriculum framework or standards always include reading as a key component. Therefore when one includes the reflection comments tied to reading, along with those comments that addressed district curriculum framework or guidelines, it is easier to see the alignment between the Likert responses on the WTS and the reflective responses. This alignment supports the WTS and SEC data that suggest district curriculum frameworks have a considerable influence on what teachers teach and how they teach. The one reflection theme that was not tapped in responses to WTS questions 19 through 24 was the influence the teachers' participation in the BSSP had on their teaching.

Interviews

As mentioned previously, shortly after the conclusion of the first year of the BSSP, the teachers in my sample were interviewed to better understand their schools and what influences the teachers' science teaching practice. Interview questions were designed to specifically address the possible influences of the district, state, administration, parents, and other sources. Examples of responses to these questions:

"Thinking about your teaching situation what influences how you teach science?"

follow:

> Well, I think what influences, how I teach science is …what students know…you know, their prior knowledge and experience and what they bring to the classroom. And also… who they are … in my classroom room all the students are either Northern Cheyenne Tribal Members or Crow Tribal Members. (Rebecca)
>
> Well, the school does get in the way of it a little bit because we have so little time. Seems like if I teach it at all, I have to grab time from here or there or someplace and like I said we just don't have a lot of time for it so, that influences it quite a bit. It usually, a lot of the time, I end up doing something just out of the book because I've got fifteen, twenty minutes, thirty minutes and you really can't set up for anything hands-on in that amount of time. (Melissa)
>
> We have a very limited time schedule. So we're maybe allowed an hour a week to teach science. And so that kind of factors in, but … I'm pretty much free to do whatever I want in that time. And I can kind of integrate it wherever I want as long as I am still teaching the math and reading. That's the most important at our school. (Angela)
>
> Well, scheduling. And we had … little time each week and then we have to follow our district benchmarks. (Sarah)

These comments suggest that in addition to time limitations and scheduling, student prior knowledge and other student characteristics have an influence on what and how these teachers teach science. As the interview progressed, additional questions about the influence of the principal and other teachers in the building were asked that resulted in comments including:

> Well, the other teacher at my grade level and I, we work together. And so, I guess we influence each other just so we could help make it easier for both of us to teach. (Sarah)
>
> My past administrator was highly…motivational and she kept us…we needed to get this done now. This principal is more of a figurehead. (laughs) (Michelle)
>
> A little bit, yeah a little bit. (Kimberly)
> All right, how about other teachers in your school? (RMJ)

> Some of them yes! Some of them stick directly to the Montana reading first format and want me to do a lot of Montana reading first, and others say, 'do it any way you can'. (Kimberly)

As Kimberly noted, sometimes the other teachers in the school have an influence on the practice of the other teachers. Rebecca agrees and comments, "A little, in some ways. For instance, … I will communicate with the fourth grade teacher (about) what she's covering in her science class. I will not cover (it) in my third grade class because … they will get it when they get over into the fourth grade. So we might … just scrape the top of the surface of the topic and then…if they are really interested in stuff you can have it next year when you get into the other classroom." These comments indicate that other members of the school staff, in these cases principals and other teachers, can have an influence on what a teacher teaches and how they teach.

Other interview prompts focused on the influence of parents and the community, and drew comments including the following:

> I guess I don't feel much influence from the parents but I do try to incorporate cultural information. (Christina)

> Even less. The community, like some, some of the parents I've worked with a little bit and, based on their suggestions I'll try to incorporate certain parts of the culture, but that's about it as far as community. (Angela)

> My parents were wonderful, but since the push was reading…basically what they got from the school was how the child was doing in the reading department. (Tiffany)

> Yes, in the fact that I tried to bring in the Crow culture into the science. But, other than that…(Sarah)

These interview responses support the data uncovered by the WTS that the parents and community have only a slight influence on the teaching from these teachers' perspective.

Beyond questions about groups who may or may not influence teaching practice, there were questions that addressed the effects of national and state policy, like NCLB legislation and state testing; the physical setting of their classroom; their access to resources; and access to ideas and professional development. Each of these areas can, and in many cases do, influence practice. In regard to national and state policy, Melissa's comment represents the responses from other members of this group:

> It cuts into the time. Because of No Child Left Behind is why we are doing so much reading and math. (Melissa)

These teachers are devoting much of their teaching time to reading and math which leaves less time for science. However, Sarah raised a concern when she commented, "Now that science is going to be tested, now they're trying to force us, you know, to make sure we cover all the standards and everything." When prompted about where the time to teach science would come from she laughed and then responded, "we're hoping it comes from reading time. (laughs) We're the teachers, we'd all like to get rid of some reading time. (laughs)" These comments provide insight into the amount of influence that national and state policy has on these teachers' practice and supports the theme of reading as a major influence on teaching practice uncovered by the WTS.

The WTS data indicated that another major influence on practice for this group was their participation in the BSSP program. Interview prompts focused on access to professional development opportunities as an influence on practice, but did not specifically mention BSSP. However, the following responses are fairly typical for the question regarding the effect that ideas and professional development have on the instructors' teaching and choice of lesson:

> Well, since I started BSSP, that's greatly impacted my science because I wanted to kind of experiment with what we're doing. So that's what I taught last year more than stuff that I previously taught. So that's… changed a little bit. (Angela)

> It (BSSP) has helped. It has really helped. I think I was at a point where, where I was (pause) saying, you know this isn't working, and then I got in the program and that has, (pause) just by example, has helped me change my teaching style. (Michelle)

> I can't believe how much more hands-on I do. All of my teaching and, actually in some ways it's easier. Because you don't have papers to take home, more papers to correct, and papers and boxes, and all over the place…but I noticed that even with reading and math, especially math, I was, doing lots and lots of hands-on and I noticed that math, just for the student to be able to be able to visualize the concept because we were learning, very basic things like addition and subtraction. They were ahead of the game because of all the hands-on. So it's really helping me. It's changing my style, my teaching style. (Tiffany)

Tiffany's change toward more hands-on science instruction led to another interview prompt: "How do your students learn science best?" She responded, "I truly believe hands-on and, and being able to touch and feel and talk about it." This and similar responses were repeated over and over again, with all ten teachers in this study indicating that hands-on learning is a key to successful science teaching with their students. I think that Melissa's comment articulates this feeling the best:

> I think they learn science best the same way that everybody does, with hands-on type materials. Now, that does not necessarily mean that they are getting a perfect understanding of it. But at least they are engaged and being engaged is something (laughs). They might not necessarily understand exactly … what we're trying to get them to understand, but like I said, they are getting something. And, I guess that is all that really matters, that we get something.

Melissa's comment suggests that while the teachers feel that hands-on learning is one of the best ways for their students to learn science there is still potential for growth in student understanding and learning.

These interviews indicated that the practices of the teachers in my study are

influenced by time constraints that are often beyond their control. Much of this time squeeze is the result of national and state policy that has mandated a focus on reading and math, often at the expense of science and other subjects. They indicated there is only a slight influence on their teaching by the parents and the community, and sometimes what they teach and how they teach, is influenced by other school staff. The teachers agree that participation in professional development programs, specifically the BSSP, has had an influence on both what they teach and how they teach and that their students tend to learn best through hands-on activities. The interviews suggested a variety of influences on these teachers' practice, but there was just one direct reference to ways that student interests and behavior influence science instruction:

> The kids! (laughs) They impact a lot what I teach. You know, if they're interested in something then that's what I go with. And then their behavior of course (laughs) will limit the time that you have to set up an experiment if they're having trouble. (Angela)

Summary of What Influences Teachers' Decisions about How They Teach Science

Overall the SEC, WTS, and interviews indicate that there are many influences that are affecting what and how the teachers in my study teach science. The SEC indicated that texts and instructional materials, state tests and results, state and district curriculum frameworks and standards/guidelines, and parents and the community had a positive influence on teaching practice. When these influences were revisited in the WTS, the results were similar and indicated that state tests and test results affected teaching practice "to some extent" far more than any of the other influences. State curriculum frameworks or standards, district curriculum frameworks or guidelines, and textbooks

and instructional materials also positively influenced teaching "to some extent". These themes continued to appear throughout the responses to the reflective question at the end of the WTS, and new influences also emerged. Chief among these was the instructional time devoted to reading, which can be tied directly to both state and district curriculum frameworks or standards/guidelines. Participation in the Big Sky Science Partnership (BSSP) professional development program was also cited frequently. Reading and BSSP were followed by state tests and test preparation, students' prior knowledge, and integrating culture as having an influence on week to week teaching. The interviews lend support to the data from the other sources, with the addition that the teachers' practice is influenced by time constraints that are often beyond their control. According to the teachers, much of this time constraint is the result of national and state policy that has mandated a focus on reading and mathematics, often at the expense of science and other subjects. The interviews aligned with the SEC and WTS results indicating that there is an evident but smaller influence on the instructors' teaching by parents and the community, and by district tests and results. The interviews reveal that what the teachers teach and how they teach, are sometimes influenced by other school staff including the principal and other teachers. The teachers agree that participation in professional development programs, specifically the BSSP, has also had an influence on what they teach and how they teach, a theme that stood out in the responses from the WTS reflection question. The data show the teachers' belief that their students learn best through hands-on activities, although they acknowledge that this approach alone is not sufficient, and they are taking other strategies that they are learning from the BSSP back to their classrooms.

CHAPTER FIVE

CONCLUSION

Introduction

The purpose of this study was to investigate the allocation of science teaching time, how that time is used, and the influences that drive decisions about the use of this time for teachers on or near the Crow and Northern Cheyenne American Indian Reservations in Montana. An additional purpose was to document how the teachers integrate culture into their teaching of science.

This study reviewed research studies, international and national assessments, and national policy recommendation in order to understand teaching time, the demands on this time and the recommended practices for teaching science to all students, especially Native Americans. A review of the literature suggested that to measure teaching time, science practice, and influences on teaching decisions it was necessary for data collection and analysis to be a multi-step process utilizing both quantitative and qualitative approaches.

The teachers in this study participated in two Surveys of Enacted Curriculum (SEC) and eight individual Weekly Teaching Surveys (WTS). These two instruments were designed to provide data that addressed all three major research questions. The WTS also had a section that addresses cultural inclusion in teaching, which was also of interest to this study. In addition to these two instruments, classroom observations for

each of the teachers in the sample, using the Horizon Classroom Observation Protocol (2006), provided data on alignment of teaching with those practices recommended by the National Science Education Standards (NSES), the research literature, and Native American organizations. Online discussion transcripts from a spring 2008 science course the teachers were taking as part of their participation in the Big Sky Science Partnership (BSSP) program and their SCOOP Notebook entries provided self-reflection data on teaching practice. Lastly teacher interviews were used to provide a more complete picture of teaching time, classroom practices, and the influences that drive teacher decisions about the amount of time to teach science, the science content, and the practice they use to teach this content.

All 14 of the teachers participating in the BSSP were invited to volunteer as part of the additional data collection needed for this research. The data collection included, but extended beyond, measures involving all BSSP teachers for the project evaluation. The primary focus of the BSSP is to equip teachers of Native American students through professional development with standards-based and culturally responsive science content and pedagogy. Ten of the active BSSP members participated in all aspects of the research and became the sample used in this study. This subset of the original group from the BSSP included teachers from seven of the eight schools on or near the Crow or Northern Cheyenne American Indian Reservation that are part of the current BSSP project. It is interesting to note that only two of the six Native American teachers participating in the BSSP opted to participate in the research study. While four of these teachers chose not to participate in this study, they were very active participants and important contributors

to the BSSP.

Summary of Findings

The results of this study are best described through the framework of the research questions and what the data reveals about each of them. The following section will summarize these findings.

Teaching Time

The first question addressed by this research was, how much time are elementary teachers able to devote to teaching science and how is this time distributed? Teaching time results must be viewed with the understanding that the state of Montana does not designate the number of minutes for instruction in each subject area for elementary grades. It is the district's' decision how many minutes of instruction they believe are necessary to meet the content and performance standards. With this in mind, results from the SEC suggest that the teachers in this study teach science for just under two hours per week; and when they teach science, lessons are typically 30 to 40 minutes long. Two-thirds of the teachers reported teaching some science during 13 to 24 weeks in a 40-week school year, or during 32.5% to 60% of the available weeks for instruction, and the remainder reported teaching science less frequently. The WTS data suggests that the time devoted to teaching science is somewhat lower than that revealed by the SEC. Findings from the WTS indicated that the teachers in this study provided about one hour and 38 minutes each week of science to their students. The WTS indicated that the teachers typically teach lessons lasting for 21 to 30 minutes, and that 60% of the lessons taught

lasted 30 minutes or less. In addition, the WTS showed that no science was taught on 183days, which comprised 45.7% of the 400 days monitored in the 80 weekly surveys completed by the teachers. The Scoop Notebook asked teachers to report the amount of time they spend on individual lessons associated with a science unit. Analysis of data from the Scoop Notebook found that these teachers most often taught science lessons between 30 and 60 minutes long during each teacher's model unit, with 19/30 (63.3%) of the Scoop lessons lasting 45 to 120 minutes. This presents a clear contrast to the WTS results showing 60% of all science lessons lasting 30 minutes or less. Themes emerging from teacher interviews indicated that instruction was generally constrained to a very rigid schedule that allocated most of the teaching time to reading/language arts first, and to a lesser extent to mathematics. Teachers commented that when they had time to teach science it was usually in 15 to 30 minute blocks, which aligns well with the WTS results, but is less than they indicated on the SEC and the Scoop. Collectively, data from the SEC, the WTS, the Scoop Notebook, and interviews indicate that most teachers in my sample teach science well under two hours a week, with one-third teaching science less than an hour a week, during one-third to six-tenths of the school year, with the majority of the individual science lessons taking 30 minutes or less, except under special circumstances such as the teachers' model units. While the most science lessons took between 21 to 30 minutes, several lessons took as little as five minutes, and one was allocated 245 minutes.

It is clear that the teachers in my study spent much less time teaching science when considering the instructional time for science allocated by teachers nationally

(e.g., NAEP, SASS, the National Survey of Science and Mathematics (described in Chapter Two of this paper), and regionally (e.g., Montana SEC results). Although the BSSP teachers reported in their 2007 and 2008 responses to the SEC that they were devoting 1.8 to 1.9 hours weekly to science instruction, the WTS and interview data indicated that this was not the case, and the time allowed for science was considerably under that reported for the elementary teachers in several large scale studies. For example, a study recently conducted by the Center on Education Policy (McMurrer, 2007) reported 2.5 hours per week for elementary science compared to 2.04 hours per week for the 2003-2004 SASS, 2-2.9 hours per week for the 2005 NAEP, 2.1 hours per week for the National Survey of Science and Mathematics Education, and 2.51 hours per week for the 91% of U. S. 4th grade teachers responding to the 2007 TIMSS who reported teaching science as a separate subject. The 9% of TIMSS 2007 4th grade teachers who reported integrating science with other subject areas estimated a lower figure of 2.04 hours per week for science. An important finding evident in the WTS data was the large variability in actual time devoted to teaching science whether one compares results across teachers, or compares weekly reports for the same teacher. This leaves a strong impression, reinforced through the interviews, that science is taught on a less regular schedule than certain other subject areas, especially reading/language arts and mathematics. While the time devoted to teaching science by many of the teachers in my study is less than that of their national and regional counterparts, given the considerable policy, scheduling and resource constraints they often faced, it was impressive that they are nonetheless teaching science.

My results show the challenges involved in obtaining consistent data about the amount and distribution of science teaching in elementary teacher's classrooms, and that results differ markedly according to the data collection tools and processes used, even with the same teachers. The Weekly Teaching Survey may have produced more accurate responses than the answers teachers provided in the national and regional studies that asked them to estimate the time devoted to science for the current or previous school year.

How Are The Teachers Using Their Teaching Time

The second question addressed by this research was, how do the teachers who teach science allocate their time for science instruction? The data from the SEC and WTS reveals that there are many activities going on during science lessons, and that these lessons can contain both activities that are considered well aligned with best practices in science as recommended by the national standards and activities that are considered less well aligned. These surveys found that many activities cited by the teachers center around engaging the students in laboratory or non-laboratory activities, investigations, or experiments, as well as whole group listening, watching demonstrations, and reading. Deeper investigation of these experiences revealed that even during laboratory and non laboratory activities, much of the time students are following step-by-step directions. The teachers reported fairly regularly engaging students in activities often associated with science inquiry including making observations and classifications, organizing and displaying data in graphs or tables, and making educated guesses, predictions, or

hypotheses. Yet the SEC results indicate that these processes were implemented in fairly guided format.

Results from the SEC and WTS imply that the teachers are meeting the national science standards and recommendations of other groups (CREDE, AISES) in several areas of their teaching, primarily by providing time for students to engage in group activities that allow them to guess, predict, hypothesize, observe, classify, organize and display data. The COP results indicate that this group of teachers exhibit more standards-based teaching practice than a national sample in three out of five areas of related practices identified by Woolbaugh (2004). The observed performance in Woolbaugh's "Lesson Design" category for teachers in this study showed that they incorporate tasks, roles and interactions that are consistent with investigative science to a modest degree, but more visibly than their counterparts in a national study. They also excel in cooperative learning by providing time for students to engage in group activities. The COP results also indicated that these teachers' practice is essentially the same as teachers in the national sample in Woolbaugh's categories of "Lesson Implementation" and "Student/Teacher Relationships."

The teachers commented both in the interviews and the self reflections in the Scoop that they value hands-on, collaborative activities as one of the best ways that their students learn, and that they use this method frequently in science, and the data from the COP, WTS, and SEC support this. Seven of the ten teachers in the sample indicated that they devote moderate to considerable amounts of their science teaching time to pair and

small group activities, which has been recognized as being a component of culturally responsive pedagogy for American Indian students.

Collectively, findings from the SEC, WTS, and COP indicate that when the teachers in my sample teach science, they typically have their students work in pairs small groups engaged in laboratory or non laboratory activities, investigations, or experiments that focus especially on observation and classification. The use of pairs or small groups during laboratory and non-laboratory activities encourages collaborative interaction among students (Swisher and Deyhle, 1987; NRC, 1996; CREDE, 2009). However, observers noted that the teachers could have leveraged to a greater degree the high level of comfort and camaraderie observed among the students toward the goal of learning science concepts, and that the teachers needed to provide more time and structure for wrap-up and "sense-making" during the lessons.

What Influences Teachers' Decisions about How They Teach Science

The third question addressed by this research was, what influences guide the teachers' decisions about how often they teach science and how they use this time? The data indicated that many factors including texts and instructional materials, state tests and results, state and district curriculum frameworks and standards/guidelines, and parents and the community had a positive influence on teaching practice from the teachers' perspective. The two most highly rated influences were selected during over 80% of the weeks monitored as influencing science instruction "to some extent" or "to a great extent." These two influences were (1) state tests or results, and (2) the state curriculum

framework or standards. Two other categories of influence, the district curriculum framework/guidelines and the textbook or materials selected by the district, were selected during two-thirds of the weeks monitored as influencing science instruction "to some extent" or "to a great extent." Parents and community were selected as influencing science teaching "to some extent" or "to a great extent" during a little over half of the instructional weeks monitored. All of these themes continued to appear throughout the responses to the WTS reflective question. However, new influences also emerged. Chief among these was the instructional time devoted to reading, which can be tied directly to both state and district curriculum frameworks or standards/guidelines. Participation in the Big Sky Science Partnership (BSSP) professional development program was also cited frequently. Reading and BSSP were followed by state tests and test preparation, students' prior knowledge, and integrating culture as having an influence on week to week science teaching. The interviews lend support to the data from the other sources with the addition that the teachers' practice is influenced by time constraints that are often beyond their control. According to the teachers, much of the limitation on time for science instruction is the result of national and state policy, which is reflected in their district and school policies that mandate a focus on reading and mathematics, often at the expense of science and other subjects. The teachers' descriptions of influences on science instruction gathered through interviews were aligned with the perceptions they expressed on the SEC and WTS indicating that there is smaller yet visible influence on the instructors' teaching by parents and the community. The interviews revealed that what the teachers teach and how they teach, are sometimes

influenced by other school staff, including the principal and other teachers. The teachers agree that participation in professional development programs, specifically the BSSP, has also had an influence on their science instruction, a theme that stood out in the responses from the WTS reflection question.

As mentioned above, the teachers indicated that parents and the community had a smaller influence on science teaching time and practice than some other factors, yet an influence was evident. In 41/80 weeks they reported there was an influence and that it was is "somewhat positive." Connections to parents and community are an important aspect of teaching in rural and reservation schools, and the data indicates that these teachers perceive themselves to have a good working relationship with both.

Overall, results from the SEC, WTS, and interviews indicate that there are many influences that are affecting what and how the teachers in my study teach science. The data also suggest that the teachers believe that their students tend to learn best through collaborative hands-on activities, although they acknowledge that this approach alone is not sufficient, and they are taking other strategies that they are learning from the BSSP back to their classrooms.

Implications for Educators

This study provides teachers with some points of reference from which to examine their science teaching practices. The literature review and the specific findings of this study provide information on how much time elementary teachers devote to science teaching, how they use this time, and how this compares to research- and standards-based

recommendations for all students, especially American Indians. Teachers can use these findings to understand their own practice and find areas of strength, weakness and potential growth.

School or district administrators can use the results of the study to understand the affect of state and district curriculum frameworks or standards on teachers' instructional time devoted to content other than reading or mathematics. They can use this information to understand the demands placed on teachers and the ramifications these policies have on the teaching of all content areas.

University level educators and professional development facilitators must understand the attributes that characterize instruction at the classroom level when planning effective professional development programs. For example, having knowledge of the time constraints already placed on teachers by state and district curriculum, what types of curriculum in science and other subject areas are already in place and the degree to which they are can be modified or are considered "untouchable" in the district, and gathering data on standard lesson length for science, and teachers' typical science teaching practice, as was done in this study, will make the design of the professional development program more focused on teachers' needs in a given setting.

Implications for Policy Makers

The focus of many legislative mandates, both at the state and national level, in recent years has been that teachers demonstrate positive impacts on student achievement, specifically in the areas of mathematics and English language arts, especially reading.

The focus on reading and mathematics achievement has exacerbated the problem of inadequate teaching time for science. Prior to 2007 science was not one of the content areas for improvement under the No Child Left Behind Legislation. However, now schools must show adequately year progress toward proficiency in science achievement and show progress toward reducing achievement gaps among various student subgroups. Cawelti (2006) warns that a serious imbalance in time for various content areas has developed as elementary schools focused on meeting expectations of high-stakes testing. McMurrer (2007) comments that many elementary schools spend about three-fourths of the time available for instruction teaching reading and math, leaving inadequate instructional time for other subjects resulting in potential gaps in student learning.

With science now being assessed, policy makers will need to better understand the influence testing and test preparation have on teaching. Melissa, a fifth grade teacher, commented, "Now that science is going to be tested, now they're trying to force us, you know, to make sure we cover all the standards and everything." When prompted about where the time to teach science would come from she laughed and then responded, "We're hoping it comes from reading time. (laughs) We're, the teachers, we'd all like to get rid of some reading time (laughs)." These comments provide insight into the amount of influence that national and state policy has on these teachers' practice and supports the theme of reading as a major influence on science teaching practice raised by others and reinforced through the findings of this study.

Teachers also commented that state tests and test preparation influenced teaching time across content areas, and these influences were often beyond their control. As

policies are implemented, including the addition of science as one of the core subject areas tested annually under No Child Left Behind, policy makers at all levels must weigh the demands these new requirements have put on teachers by constraining the amount of instructional time available for all subjects. National, state and district guidelines may need to include provisions that will address this renewed focus on science in the curriculum by restoring at least some of the teaching time that appears to have been taken from science since implementation of No Child Left Behind policies according to this study and others (e.g., Mathis, 2003, McMurrer, 2007, and Dorph, Goldstein, Lee, Lepori, Schneider, and Venkatesan, 2007).

Policies, in addition to mandating that science be tested, need to reflect the importance of preparing teachers to engage all learners in both the content and the processes of science. Results from studies (e.g., TIMSS, NAEP) make clear that some amount of time is necessary for supporting students' science learning. However, the National Science Education Standards and the Montana Office of Public Instruction provide minimal guidance in this area, suggesting that teachers structure the time available so that students are able to engage in extended investigations (NSES, 1996), and that it is the district's decision how many minutes of instruction they believe are necessary to meet the content and performance standards (OPI, 2009). Simply mandating more time for the teaching of science may alleviate the struggle to find teaching time for this subject, but at the cost of subjects not yet assessed. Additionally, if policy changes to require some increased amount of teaching time for science, what will that policy require regarding teaching practice during that time? It is equally critical that

policy provide guidelines that will recommend practices that are aligned with state and national science standards while allowing for adaptation of practice to meet local circumstances.

Recommendations for Further Research

Moving Beyond Annual Sampling of Time Devoted to Science Teaching

The Survey of Enacted Curriculum (SEC) is an instrument designed to elicit teacher responses to a variety of science teaching practices based on teacher recollection of the past year's teaching. The data from the SEC provides a snapshot of the year based on self-reported data that may not reflect actual practice. The Weekly Teaching Survey (WTS) data suggests that the time devoted to teaching science is lower than that revealed by the SEC, with the WTS indicating that these teachers spend about one hour and 40 minutes each week compared to the one hour and 54 minutes reported on both administrations of the SEC. Since the WTS was administered weekly for eight weeks rather than the once a year, like the retrospective SEC, it is possible that the results of the WTS are more representative of the actual teaching practice. It is important to provide more reliable data when creating policy. Using instruments like the WTS that lend themselves to more frequent use than other instruments can fill this need. While use of this instrument on a weekly basis for all teachers in a district or state is logistically and financially unrealistic, the WTS can be modified for use once a quarter or once every grading period to provide more representative data that can be used to guide policy decisions, or to provide more accurate information for educational researchers.

Measuring Teacher Practice

Effective professional development programs in science, like the BSSP, aim to enhance both content knowledge and improve practice, with the ultimate goal of creating positive impact on student achievement. This study focused on teaching time, teaching practice, and the influences that may drive teacher decisions about time and practice for ten teachers engaged in BSSP. Using an instrument like the WTS can provide almost immediate feedback on the effectiveness and transference of teachers' experiences during professional development sessions if used on a weekly or monthly basis. Measures of the growth in teachers' content knowledge (e.g., through rigorously designed instruments) and measures of changes in student achievement (e.g., through utilizing standardized test scores) were beyond the scope of this study. However, program evaluation studies using measures like these would add to understanding the impacts of participating in a long-term professional development program for both the teacher and his or her students. Modest research along these lines is currently being conducted by the BSSP evaluation.

Understanding Influences on Teacher Instructional Choices

Teacher instructional decisions result from the interaction of intrinsic and extrinsic factors. Understanding those factors has been a major focus of educational research for several decades. Much of the research has focused on teachers' beliefs and attitudes toward science, their understanding of science content, and confidence in their content knowledge, as major influences on teaching practice (Ford, 1992; Soodak and Podell, 1997; Tobin, Tippins, and Gallard, 1994; and Bandura, 1997). Lumpe, Haney, and Czerniak (2000) and others researchers looking at teachers participating in

professional development programs that include components recommended by current science education reform. This research found that teachers' practice is shaped by multiple factors including confidence with the content, cultural backgrounds, and external influences that were often beyond their control. The influences most frequently cited by the teachers in this study were state or district mandated assessments, curriculum standards, and the designated curriculum or textbook. These influences mirror findings in the *Looking Inside the Classroom* study (Weiss, Pasley, Smith, Banilower and Heck, 2003). As other subjects are added to those being assessed annually, it will become even more important for researchers to understand the other influences on what teachers do regarding science instruction. Cimbricz (2002) is correct in her comment that tests do matter and do influence what teachers say and do in their classrooms, but there is more going on than simply a response to testing policy. Research is needed that looks close up, perhaps through in-depth interviews, at the influence of testing in combination with other internal and environmental influences on teachers' science teaching beliefs and practice. Examples of these other factors include, but are not limited to, influences on teaching and practice due to teacher confidence, geographic isolation of the school, the local culture and community and the ways that limited budgets may impact teaching.

Summary

This study provided an examination of teaching time, teaching practice, and the influences that affect both for a small group of teachers who work on or near two rural American Indian Reservations and who participated in a content-based professional

development program. It is clear from the results that these instructors teach science regularly, but that the length of time devoted to science teaching varies considerably from instructor to instructor, and from week to week. These instructors teach science for shorter periods of time than their national counterparts, but many aspects of their science teaching practice mirror that of teachers in larger studies. The results also make it clear that their active participation and engagement in the BSSP program has contributed to their science teaching by providing them with increased confidence in their content knowledge, instructional strategies and resources, all of which, according to the teachers, have increased the time they devote to science teaching and the quality of the lessons. Additionally, the results suggest that more frequent surveys of teachers may provide more reliable data regarding teaching time, teaching practice, and influences on both. However, due to the investment of time and money needed to collect this data, it would be wise to design an instrument that can be used flexibly. Acquiring more than a single annual snapshot of the time devoted to science teaching, classroom practices, and the influences that drive teachers' instructional decisions has the potential, not only to improve teacher practice, but to also improve student learning.

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APPENDICES

APPENDIX A

SURVEYS OF ENACTED CURRICULUM (SEC)

Council of Chief State School Officers
Wisconsin Center for Education Research

SURVEYS OF ENACTED CURRICULUM®

Survey Of Instructional Practices
Teacher Survey
Grades K-8
Science

Thank you for agreeing to participate in this survey of instructional practice and content. This survey is part of a collaborative effort to provide education researchers, policymakers, administrators, and most importantly, teachers like yourself with comparative information about instruction in districts participating in the SEC Collaborative or associated initiatives from states and districts around the country. To learn more about the surveys of enacted curriculum and their use in other projects, please visit the project website: http://www.secsurvey.org

Your participation in this survey is voluntary. If you choose to participate, your personal information will remain strictly confidential. Information that could be used to identify you or used to connect you to individual results will not be shared with staff in your school, district or state. Individual respondents are never identified in any reports of results. The questionnaire poses no risk to you and there is no penalty for refusal to participate. You may withdraw from the study simply by returning the questionnaire without completing it, without penalty or loss of services or benefits to which you would be otherwise entitled.

If you have any questions regarding your rights as a research participant, please contact the University of Wisconsin-Madison School of Education's Human Subjects Committee office at (608) 262-2463.

A joint project of the Council of Chief State School Officers and the Wisconsin Center for Education Research, with funding support from the National Science Foundation and participating states and districts. Limited Copyright.

Please provide the following information:
(Note: Your personal information will be kept confidential.)

Name: _____

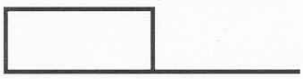
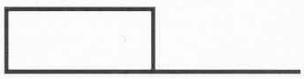
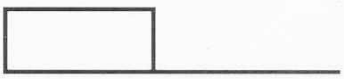
Email address: _____
(required for on-line access to individual results)

District: _____

School: _____

Date: _____

Providing your name and email address will allow you to gain access to your individual results along with results for your school and/or district.

Instructions for Selecting the Target Class --

Science Instruction -- For all questions about classroom practices please refer only to activities in the Science class that you teach. If you teach more than one Science class, select the first class that you teach each week. If you teach a split class (i.e. the class is split into more than one group for Science instruction) select only one group to describe as the target class.

Please read each question and the possible responses carefully, and then mark your response by filling in the appropriate circle in the response section. A pen or pencil may be used to complete the survey.

1 Which of these categories best describes the way classes at this school are organized?

① Departmentalized Instruction
② Taught by Subject Area Specialist (non-departmental)
③ Self-contained
④ Team taught

2 If your school is departmentalized, or you are a subject area specialist, how many different Science courses do you currently teach?

⓪ ① ② ③ ④ ⑤ ⑥ ⑦
(Number of courses taught)

3 Which term best describes the target class, or course, you are teaching?

⓪ Other
① Elem./Middle Sch Science
② General Science
③ Life Science
④ Physical Science
⑤ Earth Science
⑥ Biology
⑦ Chemistry
⑧ Physics
⑨ Coordinated / Integrated

TARGET CLASS DESCRIPTION

4 Indicate the grade level of the majority of students in the target class.

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫
K 1 2 3 4 5 6 7 8 9 10 11 12

5 How many students are in the target class?

⓪ 10 or less
① 11 to 15
② 16 to 20
③ 21 to 25
④ 26 to 30
⑤ 31 or more

6 What percentage of the students in the target class are **female**? (Estimate to the nearest ten percent.)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
Less than 10 10 20 30 40 50 60 70 80 90+ %

7 What percentage of the students in the target class are **not** Caucasian? (Estimate to the nearest ten percent.)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
Less than 10 10 20 30 40 50 60 70 80 90+ %

8 *During a typical week,* approximately how many hours will the target class spend in Science instruction?

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
(Number of instructional hours)

9 What is the average length of each class period for this targeted Science class?

⓪ Not applicable
① 30 to 40 minutes
② 41 to 50 minutes
③ Varies due to block scheduling or integrated instruction
④ 51 to 60 minutes
⑤ 61 to 90 minutes
⑥ 91 to 120 minutes

10 How many weeks total will the target Science class/course meet for this school year?

⓪ ① ②
Total # weeks = 1 to 12 13 to 24 25 to 36

11 Estimate the achievement level of the majority of students in the target class, based on national standards.

① High Achievement Levels
② Average Achievement Levels
③ Low Achievement Levels
④ Mixed Levels of Achievement

12 What percentage of students in the target class are Limited English Proficient (LEP)? (Estimate to the nearest ten percent.)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
Less than 10 10 20 30 40 50 60 70 80 90+ %

13 What is considered most in scheduling students into this class?

⓪ Ability or Achievement
① Limited English Proficiency
② Teacher Recommendation
③ Parent Request
④ No one factor more than another
⑤ Student selects

HOMEWORK (work assigned to be done *outside* of class)

Answer the following questions with regard to your target class:

14 How often do you usually assign science homework to be done outside of class?

⓪ Never (Skip to # 18)
① Less than once per week
② Once or twice per week
③ 3-4 times per week
④ Every day

15 How many minutes does the typical student spend on a normal homework assignment done outside of class?

⓪ I do not assign homework
① Less than 15 minutes
② 15-30 minutes
③ 31-60 minutes
④ 61-90 minutes
⑤ More than 90 minutes

16 Does homework done outside of class count towards student grades?

⓪ Never
① Usually does not
② Usually does
③ Always does

17 How often do you assign homework to be completed in a small group outside of class?

⓪ Never
① Less than once per week
② Once or twice per week
③ 3-4 times per week
④ Every day

AMOUNT OF HOMEWORK TIME (for the school year)

0 - None
1 - Little *(10% or less of homework time for the school year)*
2 - Some *(11-25 % of homework time for the school year)*
3 - Moderate *(26-50% of homework time for the school year)*
4 - Considerable *(50% or more of homework time for the school year)*

What percentage of the time that students in the target class spend on Science homework done outside of class do you expect them to:

		None	Little	Some	Moderate	Considerable
18	Read about science in books, magazines, or articles.	⓪	①	②	③	④
19	Answer questions from a science textbook or worksheet.	⓪	①	②	③	④
20	Solve science problems that require computation.	⓪	①	②	③	④
21	Revise and improve students' own work (for example, tests, homework assignments).	⓪	①	②	③	④
22	Collect data or information about science.	⓪	①	②	③	④
23	Work on an assignment, report, or project that takes longer than one week to complete.	⓪	①	②	③	④
24	Write about science in a report/paper.	⓪	①	②	③	④

INSTRUCTIONAL ACTIVITIES IN SCIENCE

Listed below are questions about the types of activities that students in the target class engage in during science instruction. For each activity, you are asked to estimate the relative amount of time a typical student will spend engaged in that activity over the course of a school year. The activities are not necessarily mutually exclusive; across activities, your answers will undoubtedly greatly exceed 100%. Consider each activity on its own, estimating the range that bests indicates the relative amount of science instructional time that a typical student spends over the course of a school year engaged in that activity.

AMOUNT OF INSTRUCTIONAL TIME *(for the school year)*

0 - None
1 - Little *(10% or less of instructional time for the school year)*
2 - Some *(11-25 % of instructional time for the school year)*
3 - Moderate *(26-50% of instructional time for the school year)*
4 - Considerable *(50% or more of instructional time for the school year)*

How much of the total science instructional time do students in the target class:	None	Little	Some	Moderate	Considerable
25 Listen to the teacher explain something to the class as a whole about science.	⓪	①	②	③	④
26 Read about science in books, magazines, articles (**not** textbooks).	⓪	①	②	③	④
27 Work *individually* on science assignments.	⓪	①	②	③	④
28 Write about science in a report/paper on science topics.	⓪	①	②	③	④
29 Do a laboratory activity, investigation, or experiment.	⓪	①	②	③	④
30 Watch the teacher demonstrate a scientific phenomenon.	⓪	①	②	③	④
31 Collect data (other than laboratory activities).	⓪	①	②	③	④
32 Work *in pairs or small groups* (other than laboratory activities).	⓪	①	②	③	④
33 Do a science activity with the class **outside** the classroom or science laboratory (for example, field trips or research).	⓪	①	②	③	④
34 Use computers, calculators or other educational technology to learn science.	⓪	①	②	③	④
35 Maintain and reflect on a science portfolio of their own science work.	⓪	①	②	③	④
36 Take a quiz or test.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME (in laboratory activities, investigations or experiments)

0 - None

1 - Little *(10% or less of instructional time in laboratory activities, investigations, or experiments)*

2 - Some *(11-25 % of instructional time in laboratory activities, investigations, or experiments)*

3 - Moderate *(26-50% of instructional time in laboratory activities, investigations, or experiments)*

4 - Considerable *(50% or more of instructional time in laboratory activities, investigations, or experiments)*

When students in the target class are engaged in *laboratory activities, investigations, or experiments* as part of science instruction, how much time do they:	None	Little	Some	Moderate	Considerable
37 Make educated guesses, predictions, or hypotheses.	⓪	①	②	③	④
38 Follow step-by-step directions.	⓪	①	②	③	④
39 Use science equipment or measuring tools.	⓪	①	②	③	④
40 Collect data.	⓪	①	②	③	④
41 Change a variable in an experiment to test a hypothesis.	⓪	①	②	③	④
42 Organize and display information in tables or graphs.	⓪	①	②	③	④
43 Analyze and interpret science data.	⓪	①	②	③	④
44 Design their own investigation or experiment to solve a scientific question.	⓪	①	②	③	④
45 Make observations/classifications.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME (in pairs or small groups)

0 - None
1 - Little *(10% or less of instructional time in pairs or small groups)*
2 - Some *(11-25 % of instructional time in pairs or small groups)*
3 - Moderate *(26-50% of instructional time in pairs or small groups)*
4 - Considerable *(50% or more of instructional time in pairs or small groups)*

When students in the target class work in *pairs or small groups* (other than in the science laboratory), how much time do they:	None	Little	Some	Moderate	Considerable
46 Talk about ways to solve science problems, such as investigations.	⓪	①	②	③	④
47 Complete written assignments from the textbook or workbook.	⓪	①	②	③	④
48 Write up results or prepare a presentation from a laboratory activity, investigation, experiment or a research project.	⓪	①	②	③	④
49 Work on an assignment, report or project over an extended period of time.	⓪	①	②	③	④
50 Work on a writing project or entries for portfolios seeking peer comments to improve work.	⓪	①	②	③	④
51 Review assignments or prepare for a quiz or test.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME (collecting science data or information)

0 - None
1 - Little *(10% or less of instructional time collecting science data or information)*
2 - Some *(11-25 % of instructional time collecting science data or information)*
3 - Moderate *(26-50% of instructional time collecting science data or information)*
4 - Considerable *(50% or more of instructional time collecting science data or information)*

When students in the target class *collect science data or information* from books, magazines, computers, or other sources (other than laboratory activities), how much time do they:	None	Little	Some	Moderate	Considerable
52 Have class discussions about the data.	⓪	①	②	③	④
53 Organize and display the information in tables or graphs.	⓪	①	②	③	④
54 Make a prediction based on the data.	⓪	①	②	③	④
55 Analyze and interpret the information or data, orally or in writing.	⓪	①	②	③	④
56 Make a presentation to the class on the data, analysis, or interpretation.	⓪	①	②	③	④

AMOUNT OF INSTRUCTIONAL TIME *(using calculators, computers or other ed. technology)*

0 - None

1 - Little *(10% or less of instructional time using calculators, computers, or other ed. technology)*

2 - Some *(11-25 % of instructional time using calculators, computers, or other ed. technology)*

3 - Moderate *(26-50% of instructional time using calculators, computers, or other ed. technology)*

4 - Considerable *(50% or more of instructional time using calculators, computers, or other ed. technology)*

When students in the target class are engaged in activities that involve the use of *calculators, computers, or other educational technology* as part of science instruction, how much time do they:	None	Little	Some	Moderate	Considerable
57 Learn facts.	⓪	①	②	③	④
58 Practice procedures.	⓪	①	②	③	④
59 Use sensors and probes (for example, CBL's).	⓪	①	②	③	④
60 Retrieve or exchange data or information (for example, using the Internet or partnering with another class).	⓪	①	②	③	④
61 Display and analyze data.	⓪	①	②	③	④
62 Solve problems using simulations.	⓪	①	②	③	④

ASSESSMENTS

For items 63-70, indicate how often you use each of the following when assessing students in the target science class.

		Never	1 - 4 times per year	1 - 3 times per month	1 - 3 times per week	4 - 5 times per week
63	Objective items (for example, multiple choice, true/false).	⓪	①	②	③	④
64	Short answer (for example, fill-in-the-blank).	⓪	①	②	③	④
65	Extended response item for which student must explain or justify solution.	⓪	①	②	③	④
66	Performance tasks or events (for example, hands-on activities).	⓪	①	②	③	④
67	Individual or group demonstration, presentation.	⓪	①	②	③	④
68	Science projects.	⓪	①	②	③	④
69	Portfolios.	⓪	①	②	③	④
70	Systematic observation of students.	⓪	①	②	③	④

INSTRUCTIONAL INFLUENCES

For items 71-80, indicate the degree to which each of the following influences what you teach in the target science class.

		Not Applicable	Strong Negative Influence	Somewhat Negative Influence	Little or No Influence	Somewhat Positive Influence	Strong Positive Influence
71	Your state's curriculum framework or content standards.	⓪	①	②	③	④	⑤
72	Your district's curriculum framework or guidelines.	⓪	①	②	③	④	⑤
73	Textbook / instructional materials.	⓪	①	②	③	④	⑤
74	State tests or results.	⓪	①	②	③	④	⑤
75	District tests or results.	⓪	①	②	③	④	⑤
76	National science education standards.	⓪	①	②	③	④	⑤
77	Your experience in pre-service preparation.	⓪	①	②	③	④	⑤
78	Students' special needs.	⓪	①	②	③	④	⑤
79	Parents/community.	⓪	①	②	③	④	⑤
80	Preparation of students for the next grade or level.	⓪	①	②	③	④	⑤

CLASSROOM INSTRUCTIONAL PREPARATION

For items 81-90, please indicate how well prepared you are to:		Not Well Prepared	Somewhat Prepared	Well Prepared	Very Well Prepared
81	Teach science at your assigned level.	⓪	①	②	③
82	Integrate science with other subjects.	⓪	①	②	③
83	Provide science instruction that meets science content standards (district, state, or national).	⓪	①	②	③
84	Use a variety of assessment strategies (including objective and open-ended formats).	⓪	①	②	③
85	Manage a class of students who are using hands-on or laboratory activities.	⓪	①	②	③
86	Take into account students' prior conceptions about natural phenomena when planning.	⓪	①	②	③
87	Teach students with disabilities.	⓪	①	②	③
88	Teach classes with students with diverse abilities.	⓪	①	②	③
89	Teach science to students from a variety of cultural backgrounds.	⓪	①	②	③
90	Teach science to students who have Limited English Proficiency.	⓪	①	②	③

TEACHER OPINIONS

Please indicate your opinion about each of the statements below:		Strongly Disagree	Disagree	Neutral / Undecided	Agree	Strongly Agree
91	Laboratory-based science classes are more effective than non-laboratory classes.	⓪	①	②	③	④
92	It is important for students to learn basic scientific terms and formulas before learning underlying concepts and principles.	⓪	①	②	③	④
93	I am supported by colleagues to try out new ideas in teaching science.	⓪	①	②	③	④
94	I am required to follow rules at this school that conflict with my best professional judgment about teaching and learning science.	⓪	①	②	③	④
95	Science teachers in this school regularly observe each other teaching classes.	⓪	①	②	③	④
96	Science teachers in this school trust each other.	⓪	①	②	③	④
97	It's OK in this school to discuss feelings, worries, and frustrations with other science teachers.	⓪	①	②	③	④
98	Science teachers respect other teachers who take the lead in school improvement efforts.	⓪	①	②	③	④
99	It's OK in this school to discuss feelings, worries, and frustrations with the principal.	⓪	①	②	③	④
100	The principal takes personal interest in the professional development of the teachers.	⓪	①	②	③	④

PROFESSIONAL DEVELOPMENT ACTIVITIES IN SCIENCE EDUCATION

In answering the following items, consider all the professional development activities related to Science content or Science education that you have participated in between ***June 1st of last year and May 31st of this year****. Professional development refers to a variety of activities intended to enhance your professional knowledge and skills, including in-service training, teacher networks, course work, institutes, committee work, and mentoring. In-service training is professional development offered by your school or district to enhance your professional responsibilities and knowledge. Workshops are short term learning opportunities that can be located in your school or elsewhere. Institutes are longer term professional learning opportunities, for example, of a week or longer in duration.*

	How Often?	How many hours?
	⓪ Never ③ 3-4 times	⓪ N/A ③ 16-35
	① Once ④ 5-10 times	① 1-6 hrs. ④ 36-60
	② Twice ⑤ >10 times	② 7-15 hrs. ⑤ 61+ hrs.
101 For the time period referenced above, how often, and for how many total hours, have you participated in workshops or in-service training related to Science or Science education?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤
102 For the time period referenced above, how often, and for how many total hours, have you participated in summer institutes related to Science or Science education?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤
103 For the time period referenced above, how often have you attended college courses related to Science or Science education and about how many hours did you spend in class?	⓪ ① ② ③ ④ ⑤	⓪ ① ② ③ ④ ⑤

Between June 1st of last year and May 31st of this year, how frequently have you engaged in each of the following activities related specifically to the teaching and learning of Science?

	Never	Once or twice a year	Once or twice a term	Once or twice a month	Once or twice a week	Almost daily
104 Attended conferences related to science or science education.	⓪	①	②	③	④	⑤
105 Participated in teacher study group.	⓪	①	②	③	④	⑤
106 Participated in a teacher network, or collaborative of teachers supporting professional development.	⓪	①	②	③	④	⑤
107 Acted as a coach or mentor to other teachers or staff in your school.	⓪	①	②	③	④	⑤
108 Received coaching or mentoring.	⓪	①	②	③	④	⑤
109 Participated in a committee or task force focused on curriculum and instruction.	⓪	①	②	③	④	⑤
110 Engaged in informal self-directed learning (for example, discussion with colleague about science or science education topics, read a journal article on sceince or science education, used the internet to enrich knowledge and skills).	⓪	①	②	③	④	⑤

Thinking again about all of your professional development activities in Science or Science education between June 1st of last year and May 31st of this year, how often have you:

		Never	Rarely	Some times	Often
111	Observed demonstrations of teaching techniques.	⓪	①	②	③
112	Led group discussions.	⓪	①	②	③
113	Developed curricula or lesson plans, which other participants or the activity leader reviewed.	⓪	①	②	③
114	Reviewed student work or scored assessments.	⓪	①	②	③
115	Developed assessments or tasks.	⓪	①	②	③
116	Practiced what you learned and received feedback.	⓪	①	②	③
117	Received coaching or mentoring in the classroom.	⓪	①	②	③
118	Gave a lecture or presentation to colleagues.	⓪	①	②	③

Thinking about all of your professional development activities between June 1st of last year and May 31st of this year, indicate how often they have been:

		N/A	Never	Rarely	Some times	Often
119	Designed to support the school-wide improvement plan adopted by your school.	⑨	⓪	①	②	③
120	Consistent with your science department or grade level plan to improve teaching.	⑨	⓪	①	②	③
121	Consistent with your own goals for your professional development.	⑨	⓪	①	②	③
122	Based explicitly on what you had learned in earlier professional development activities.	⑨	⓪	①	②	③
123	Followed up with related activities that built upon what you learned as part of the activity.	⑨	⓪	①	②	③

Between June 1st of last year and May 31st of this year, have you participated in professional development activities in Science or Science education in the following ways?

		No	Yes
124	I participated in professional development activities with most or all of the teachers from my school.	⓪	①
125	I participated in professional development activities with most or all of the teachers from my department or grade level.	⓪	①
126	I participated in professional development activities *not* attended by other staff members from my school.	⓪	①
127	I discussed what I learned with other teachers in my school or department who did *not* attend the activity.	⓪	①

How much emphasis did your professional development activities in Science or Science education place on the following topics?

		None	Slight	Moderate	Great
128	State science content standards (for example, what they are and how they are used).	⓪	①	②	③
129	Alignment of science instruction to curriculum.	⓪	①	②	③
130	Instructional approaches (for example, use of manipulatives).	⓪	①	②	③
131	In-depth study of science or specific concepts within science (for example, earth science).	⓪	①	②	③
132	Study of how children learn particular topics in science.	⓪	①	②	③
133	Individual differences in student learning.	⓪	①	②	③
134	Meeting the learning needs of special populations of students (for example, second language learners; students with disabilities).	⓪	①	②	③
135	Classroom science assessment (for example, diagnostic approaches, textbook-developed tests, teacher-developed tests).	⓪	①	②	③
136	State or district science assessment (for example, preparing for assessments, understanding assessments, or interpreting assessments).	⓪	①	②	③
137	Interpretation of assessment data for use in science instruction.	⓪	①	②	③
138	Technology to support student learning in science.	⓪	①	②	③

TEACHER CHARACTERISTICS

139 Please indicate your gender.

Female ① Male ②

140 Please indicate your ethnicity/race.

Indicate all that apply

① American Indian or Alaska Native
② Asian
③ Black or African American
④ Hispanic or Latino
⑤ Native Hawaiian or Other Pacific Islander
⑥ White

	Less than 1 year	1 - 2 years	3 - 5 years	6 - 8 years	9 - 11 years	12 - 15 years	More than 1 years
141 How many years have you taught science prior to this year?	⓪	①	②	③	④	⑤	⑥
142 How long have you been assigned to teach at your current school?	⓪	①	②	③	④	⑤	⑥

	Does not apply	BA or BS	MA or MS	Multiple MA or MS	Ph.D. or Ed.D.	Other
143 What is the highest degree you hold?	⓪	①	②	③	④	⑤

144 What was your major field of study for the bachelors degree?

① Elementary Education
② Middle School Education
③ Science Education
④ Science
⑤ Science Education and science
⑥ Other Disciplines (includes other Education fields, Science, History, English, Foreign Languages, etc.)

145 **If applicable**, what was your **major field** of study for the **highest degree you hold** beyond a bachelors degree?

① Elementary Education
② Middle School Education
③ Science Education
④ Science
⑤ Science Education and science
⑥ Other Disciplines (includes other Education fields, Mathematics, History, English, Foreign Languages,

146 What type(s) of state certification do you currently have?

Indicate all that apply

① Emergency or Temporary Certification
② Elementary Grades Certification
③ Middle Grades Certification
④ Secondary certification in a field other than science
⑤ Secondary science Certification

FORMAL COURSE PREPARATION

Please indicate the number of *quarter or semester courses* that you have taken at the undergraduate or graduate level in each of the following areas:

		(Number of courses)									
		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17+
147	Biology / Life science	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
148	Physics / Chemistry / Physical science	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
149	Geology/ Astronomy/ Earth science	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
150	Science Education	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

This is the end of the Instructional Practices portion of the survey. Please continue on to complete the Instructional Content portion. Thank you.

APPENDIX B

CULTURAL INCLUSION SURVEY (CIS)

Please indicate how often you included each of the following items in your math/science instruction during the 2006-'07 school year.

151) Traditional stories from local Tribes

Never O Rarely O Sometimes O Often O

152) Content about contemporary local Tribal issues

Never O Rarely O Sometimes O Often O

153) Historical content about local American Indian Tribes

Never O Rarely O Sometimes O Often O

154) A fieldtrip to a cultural site significant to local American Indian Tribes

Never O Rarely O Sometimes O Often O

155) Visit by a Tribal member to your class to share cultural information

Never O Rarely O Sometimes O Often O

156) Contact a Tribal member to obtain culture related information or resources

Never O Rarely O Sometimes O Often O

Please indicate how often you had each of the following items accessible to students in your classroom during the 2006-'07 school year.

157) Age appropriate books about local Tribal cultures

Never O Rarely O Sometimes O Often O

158) Bulletin boards/displays that include cultural content

Never O Rarely O Sometimes O Often O

159) Posted words or phrases in local Native languages

Never O Rarely O Sometimes O Often O

160) American Indian music

Never O Rarely O Sometimes O Often O

161) Locally made American Indian crafts or art work

Never O Rarely O Sometimes O Often O

162) Pictures or videos that address local Tribal cultures

Never O Rarely O Sometimes O Often O

163) Other (Please specify.) _____

Please indicate how frequently you used each of the following strategies or items in your science instruction during the 2006-'07 school year.

164) Collaborative learning groups

Never O Rarely O Sometimes O Often O

165) Strategies chosen to address diverse learning styles

Never O Rarely O Sometimes O Often O

166) Strategies that assist learners who are Limited English Proficient (e. g., frequent use of graphics, models, other visuals; moving from concrete to abstract; contextualized use of vocabulary)

Never O Rarely O Sometimes O Often O

167) Alternative assessment

Never O Rarely O Sometimes O Often O

168) Local Native language

Never O Rarely O Sometimes O Often O

169) Formative assessment with direct feedback to students

Never O Rarely O Sometimes O Often O

170) Private one on one teacher-student discussion of student learning

Never O Rarely O Sometimes O Often O

171) Examination of content for cultural bias

Never O Rarely O Sometimes O Often O

172) Extended wait time

Never O Rarely O Sometimes O Often O

173) Interaction with every student's parents or guardians

Never O Rarely O Sometimes O Often O

174) Working with Tribal elders or other community member as guest teachers

Never O Rarely O Sometimes O Often O

175) Mentoring of students by adults other than the classroom teacher

Never O Rarely O Sometimes O Often O

176) Opportunities for private practice precede public demonstration of proficiency

Never O Rarely O Sometimes O Often O

177) Practical application of science knowledge by students in classroom activities

Never O Rarely O Sometimes O Often O

178) Art based instructional methods (e.g., metaphors, storytelling, music, etc.)

Never O Rarely O Sometimes O Often O

179) Examination of instructional methods for cultural bias

Never O Rarely O Sometimes O Often O

180) Examination of instructional content for cultural bias

Never O Rarely O Sometimes O Often O

181) Teaching core science content using a local or place based context

Never O Rarely O Sometimes O Often O

182) Teaching American Indian traditional science knowledge along with your "regular" science content

Never O Rarely O Sometimes O Often O

183) Open ended problem based learning

Never O Rarely O Sometimes O Often O

184) Observational learning strategies (e.g., adult or peer modeling, demonstrations, apprenticeships)

Never O Rarely O Sometimes O Often O

Please indicate how frequently you participated in each of the following activities during the 2006-‘07 school year.

185) Planning your school’s science professional development

Never O Rarely O Sometimes O Often O

186) Making significant contributions to developing your school’s science education program

Never O Rarely O Sometimes O Often O

187) Voluntarily trying out innovative science curriculum content and methods

Never O Rarely O Sometimes O Often O

188) Making decisions about your school’s science materials purchases

Never O Rarely O Sometimes O Often O

189) Working collaboratively with colleagues to develop your school’s science program

Never O Rarely O Sometimes O Often O

190) Voluntarily sharing math/science instructional activities and resources with your colleagues

Never O Rarely O Sometimes O Often O

191) Working with your school and/or district administrators to improve your school’s science instruction

Never O Rarely O Sometimes O Often O

APPENDIX C

WEEKLY TEACHING SURVEY (WTS)

BSSP Weekly Science Teaching Survey

Name:_____ School:_____ Grade: _____

This survey describes my science teaching the week of (dates)
_____

In the space provide please record how much time in minutes you spent teaching science each day this week. Monday _____ Tuesday _____ Wednesday _____ Thursday_____ Friday _____

Answer the following questions regarding your science teaching this week. For positive responses please circle the percentage of time your teaching was devoted to this activity:

Did your students:

1. Listen to you explain something to the whole class?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

2. Read about science (not in the textbook)?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

3. Work individually on science assignments?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

4. Watch you do a science demonstration?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

5. Take a quiz or test?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

6. Do a laboratory or non laboratory activity, investigation, or experiment?
   None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

If you responded "NONE" to number 6 please skip to question 7

Please circle the types of science activities your students engaged in this week.

Desktop activities
Book work
Laboratory setting
Classroom
Outside activities
Web based activities
Other (please describe): _____

a. students develop the questions they want to investigate
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

b. students use science equipment or measuring tools to collect data
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

c. students make observations/classifications
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

d. students make educated guesses, predictions, or hypotheses
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

e. students analyze and interpret science data
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

f. students design their own investigation or experiment
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

g. students are provided time to discuss results
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

h. students make presentation to the class on the data/information
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

7. Work in pairs or small groups - other than in lab etc.?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

If you responded "NONE" to number 7 please skip to question 8

a. complete written assignments from text/workbook
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

b. review assignments or prepare for quiz or test
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

c. students talk about ways to solve science problems
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

d. write-up results or prepare presentation
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

e. work on an assignment, report, or project that (1 week +)
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

f. explain science concepts to other members of the group
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

8. Write about science in a report/paper on science?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

9. Work at their own pace?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

10. Participate in discussions to further science understanding?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

11. Participate in activities they generate, organize, or direct?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

12. Plan and participate in community-based learning activities?
None Little – 10% or Less Some – 11 – 25% Moderate – 26 – 50% Considerable – 50% or More

Reflecting back on your science teaching this week, please respond to the following statements:

13. My science teaching contains connections to historical and contemporary local Tribal issues.

yes no

If you answer yes to number 13 please respond to the following:

a. I include traditional stories from local cultures in my teaching.
Not at all To some extent To a great extent

b. I include science content about contemporary local issues.
Not at all To some extent To a great extent

c. I include historical content about local cultures in science.
Not at all To some extent To a great extent

d. I include Tribal members or elders as a cultural resource.
Not at all To some extent To a great extent

14. I connect my science teaching to what students already know
Not at all To some extent To a great extent

15. I integrate my science teaching into other subjects.
Not at all To some extent To a great extent

16. I integrate students' everyday life into my science teaching.
Not at all *To some extent* *To a great extent*

17. I integrate students' prior conceptions into my science teaching.
Not at all *To some extent* *To a great extent*

18. I integrate science standards into my teaching.
Not at all *To some extent* *To a great extent*

Questions 19 through 23 are two part questions that concern both the extent of the influence <u>and</u> the positive or negative degree of that influence. For each question, please circle your response for part (a) and (b).

19. The parents/community influences what and how I teach.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

20. State tests or results influence what and how I teach.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

21. State curriculum framework or standards influence what and how I teach.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

22. District curriculum framework or standards influence what and how I teach.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

23. The textbook and/or instructions materials selected by the district.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

24. District level tests or results influence what and how I teach.
(a) Not at all *To some extent* *To a great extent*
(b) Strongly negative *Somewhat negative* *Little or No influence* *Somewhat positive* *Strongly positive*

Reflection Question:

25. Please write a short reflection on one or more of the factor(s) below that had the greatest influence on what science you taught this week, and how you taught it. Include specific examples whenever possible. The factor(s) you reflect upon about might include:

-- What my students already know -- State or district tests or results
-- Parent/community influences -- Textbook or instructional materials available
-- State or district curriculum framework or standards -- OTHER

APPENDIX D

CLASSROOM OBSERVATION PROTOCOL (COP)

NOTE: This form is included for information purposes only. Evaluators will need to complete the form on the Web.

2005–06 Local Systemic Change Classroom Observation Protocol[1]

BACKGROUND INFORMATION

Project _____ Date of Observation _____

LSC ID[2] _____ Time of Observation:

Start _____ End _____

Subject Observed[3] _____ Observer _____

Grade Level _____ Observer's Role in Project:

___ Lead Evaluator

___ Other Certified Observer

SECTION ONE: CONTEXTUAL BACKGROUND AND ACTIVITIES

In this section, please fill in the circles that best describe the class. ***For each item, be sure to fill in all responses that apply.***

I. Classroom Demographics and Context

A. What is the total number of students in the class at the time of the observation?

- O 15 or fewer
- O 16–20
- O 21–25
- O 26–30
- O 31 or more

B. What is the approximate percentage of white (not Hispanic origin) students in this class?

- O 0–10 percent
- O 11–25 percent
- O 26–50 percent
- O 51–75 percent
- O 76–100 percent

C. Indicate the *teacher's*:

1. Gender
   - O Male O Female
2. Race/Ethnicity
   - O African-American (not Hispanic origin)
   - O American Indian or Alaskan Native
   - O Asian or Pacific Islander
   - O Hispanic
   - O White (not Hispanic origin)
   - O Other

D. If applicable, indicate the *teacher aide's*:

1. Gender
   - O Male O Female
2. Race/Ethnicity
   - O African-American (not Hispanic origin)
   - O American Indian or Alaskan Native
   - O Asian or Pacific Islander
   - O Hispanic
   - O White (not Hispanic origin)
   - O Other

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[1] Be sure you have read the "2005–06 Local Systemic Change Classroom Observations: Guidelines for Evaluators" and have completed the "Pre-Classroom Observation Interview" before observing the class.

[2] Use the LSC ID number as indicated in the Classroom Observation Sample provided by HRI.

[3] In mathematics/science projects observe the subject for which the teacher was sampled.

E. Rate the adequacy of the physical environment.

1 Classroom resources:

E. Rate the adequacy of the physical environment.

1. Classroom resources:

O	O	O	O	O
1	2	3	4	5
Sparsely equipped				Rich in resources

2. Classroom Space:

O	O	O	O	O
1	2	3	4	5
Crowded				Adequate space

3. Room arrangement:

O	O	O	O	O
1	2	3	4	5
Inhibited interactions among students				Facilitated interactions among students

II. Lesson Description

unit

In a paragraph or two, describe the lesson you observed. Include where this lesson fits in the overall unit of study. Be sure to include enough detail to provide a context for your ratings of this lesson and also to allow you to recall the details of this lesson when needed in future years for longitudinal analysis.

III. Purposes of Lesson

A. Indicate the *major*[4] *content area(s)* of this lesson or activity.

- O 1. Numeration and number theory
- O 2. Computation
- O 3. Estimation
- O 4. Measurement
- O 5. Patterns and relationships
- O 6. Pre-algebra
- O 7. Algebra
- O 8. Geometry and spatial sense
- O 9. Functions (including trigonometric functions) and pre-calculus concept
- O 10. Data collection and analysis
- O 11. Probability
- O 12. Statistics (e.g., hypothesis tests, curve-fitting, and regression)
- O 13. Topics from discrete mathematics (e.g., combinatorics, graph theory, recursion)
- O 14. Mathematical structures (e.g., vector spaces, groups, rings, fields)
- O 15. Calculus
- O 16. Life Science (please specify: _____)
- O 17. Physical science (please specify: _____)
- O 18. Earth/space sciences
  - O a. Astronomy
  - O b. Oceanography
  - O c. Geology
  - O d. Meteorology
  - O e. Environmental sciences
- O 19. Engineering and design principles
- O 20. History of mathematics/science
- O 21. None of the above (please explain)

[4] "Major" means was used or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

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Horizon Research, Inc. 2005–06 Core Evaluation Manual: Classroom Observation Protocol - Page 2 September 2005

B. Indicate the *primary intended purpose(s)* of this lesson or activity based on the pre- and/or post-observation interviews with the teacher.

- O 1. Identifying prior student knowledge
- O 2. Introducing new concepts
- O 3. Developing conceptual understanding
- O 4. Reviewing mathematics/science concepts
- O 5. Developing problem-solving skills
- O 6. Learning mathematics/science processes, algorithms, or procedures
- O 7. Learning vocabulary/specific facts
- O 8. Practicing computation for mastery
- O 9. Developing appreciation for core ideas in mathematics/science
- O 10. Developing students' awareness of contributions of scientists/mathematicians of diverse backgrounds
- O 11. Assessing student understanding

IV. Instructional Materials

A. Is this lesson based on instructional materials designated for use by this LSC?

O Yes O No, SKIP to Part V below

B. Indicate the *single* set of LSC-designated instructional materials intended to form the basis of this lesson (e.g., FOSS; Insights; STC; Investigations in Number, Data, and Space; Connected Math; IMP; SEPUP), based on the information provided in the pre-observation interview.

Please specify. _____

C. How closely did the lesson adhere to the instructions provided in the teacher's manual?

O Exactly, SKIP to Part V below
O Almost totally O Mostly O Somewhat O A little O Hardly at all

D. How did the modifications affect the quality of the lesson design?

O Helped a lot O Helped a little O Neutral O Hurt a little O Hurt a lot

V. Classroom Instruction

A. Indicate the *major*[5] *way(s)* in which student activities were structured.

O As a whole group O As small groups O As pairs O As individuals

B. Indicate the *major*[5] *way(s)* in which students engaged in class activities.

O Entire class was engaged in the same activities at the same time.
O Groups of students were engaged in different activities at the same time (e.g., centers).

[5] "Major" means was used or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

C. Indicate the *major*[6] *activities* of students in this lesson. When choosing an "umbrella" category, be sure to indicate subcategories that apply as well. (For example, if you mark "listened to a presentation," indicate by whom.)

- O 1. Listened to a presentation:
  - O a. By teacher (would include: demonstrations, lectures, media presentations, extensive procedural instructions)
  - O b. By student (would include informal, as well as formal, presentations of their work)
  - O c. By guest speaker/"expert" serving as a resource
- O 2. Engaged in discussion/seminar:
  - O a. Whole group
  - O b. Small groups/pairs
- O 3. Engaged in problem solving/investigation:
  - O a. Worked with manipulatives
  - O b. Played a game to build or review knowledge/skills
  - O c. Followed specific instructions in an investigation
  - O d. Had some latitude in designing an investigation
  - O e. Recorded, represented and/or analyzed data
  - O f. Recognized patterns, cycles or trends
  - O g. Evaluated the validity of arguments or claims
  - O h. Provided an informal justification or formal proof
- O 4. Engaged in reading/reflection/written communication about mathematics or science:
  - O a. Read about mathematics/science
  - O b. Answered textbook/worksheet questions
  - O c. Reflected on readings, activities, or problems individually or in groups
  - O d. Prepared a written report
  - O e. Wrote a description of a plan, procedure, or problem-solving process
  - O f. Wrote reflections in a notebook or journal
- O 5. Used technology/audio-visual resource:
  - O a. To develop conceptual understanding
  - O b. To learn or practice a skill
  - O c. To collect data (e.g., probeware)
  - O d. As an analytic tool (e.g., spreadsheets or data analysis)
  - O e. As a presentation tool
  - O f. For word processing or as a communications tool (e.g., e-mail, Internet, Web)
- O 6. Other activities
  - O a. Arts and crafts activity
  - O b. Listened to a story
  - O c. Wrote a poem or story
  - O d. Other (Please specify.) _____

[6] "Major" means was used or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

D. Comments

Please provide any additional information you consider necessary to capture the activities or context of this lesson. Include comments on any feature of the class that is so salient that you need to get it "on the table" right away to help explain your ratings; for example, the class was interrupted by a fire drill, the kids were excited about an upcoming school event, or the teacher's tone was so warm (or so hostile) that it was an overwhelmingly important feature of the lesson.

SECTION TWO: RATINGS

In Section One of this form, you documented what occurred in the lesson. In this section, you are asked to rate each of a number of key indicators in four different categories, from 1 (not at all) to 5 (to a great extent). You may list any additional indicators you consider important in capturing the essence of this lesson and rate these as well. Use your "Ratings of Key Indicators" (Part A) to inform your "Synthesis Ratings" (Part B). It is important to indicate in "Supporting Evidence for Synthesis Ratings" (Part C) what factors were most influential in determining your synthesis ratings and to give specific examples or quotes to illustrate those factors.

Note that any one lesson is not likely to provide evidence for every single indicator; use 6, "Don't know" when there is not enough evidence for you to make a judgment. Use 7, "N/A" (Not Applicable) when you consider the indicator inappropriate given the purpose and context of the lesson. Section Two concludes with ratings of the likely impact of instruction, and a capsule description of the lesson.

I. Design

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't know	N/A
1. The design of the lesson incorporated tasks, roles, and interactions consistent with investigative mathematics/science.	1	2	3	4	5	6	7
2. The design of the lesson reflected careful planning and organization.	1	2	3	4	5	6	7
3. The instructional strategies and activities used in this lesson reflected attention to students' experience, preparedness, and/or learning styles.	1	2	3	4	5	6	7
4. The resources available in this lesson contributed to accomplishing the purposes of the instruction.	1	2	3	4	5	6	7
5. The instructional strategies and activities reflected attention to issues of access, equity, and diversity for students (e.g., cooperative learning, language-appropriate strategies/materials).	1	2	3	4	5	6	7
6. The design of the lesson encouraged a collaborative approach to learning.	1	2	3	4	5	6	7
7. Adequate time and structure were provided for "sense-making."	1	2	3	4	5	6	7
8. Adequate time and structure were provided for wrap-up.	1	2	3	4	5	6	7
9. Formal assessments of students were consistent with investigative mathematics/science.	1	2	3	4	5	6	7
10. Design for future instruction takes into account what transpired in the lesson.	1	2	3	4	5	6	7
11. _____	1	2	3	4	5		

B. Synthesis Rating

1	2	3	4	5
Design of the lesson not at all reflective of best practice in mathematics/science education				Design of the lesson extremely reflective of best practice in mathematics/science education

C. Supporting Evidence for Synthesis Rating

II. Implementation

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't know	N/A
1. The instruction was consistent with the underlying approach of the instructional materials designated for use by the LSC.	1	2	3	4	5	6	7
2. The instructional strategies were consistent with investigative mathematics/science.	1	2	3	4	5	6	7
3. The teacher appeared confident in his/her ability to teach mathematics/science.	1	2	3	4	5	6	7
4. The teacher's classroom management style/strategies enhanced the quality of the lesson.	1	2	3	4	5	6	7
5. The pace of the lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.	1	2	3	4	5	6	7
6. The teacher was able to "read" the students' level of understanding and adjusted instruction accordingly.	1	2	3	4	5	6	7
7. The teacher's questioning strategies were likely to enhance the development of student conceptual understanding/problem solving (e.g., emphasized higher order questions, appropriately used "wait time," identified prior conceptions and misconceptions).	1	2	3	4	5	6	7
8. The lesson was modified as needed based on teacher questioning or other student assessments.	1	2	3	4	5	6	7
9. _____	1	2	3	4	5		

B. Synthesis Rating

1	2	3	4	5
Implementation of the lesson not at all reflective of best practice in mathematics/science education				Implementation of the lesson extremely reflective of best practice in mathematics/science education

C. Supporting Evidence for Synthesis Rating

III. Mathematics/Science Content

A. Ratings of Key Indicators

	Not at all				To a great extent	Don't know	N/A
1. The mathematics/science content was significant and worthwhile.	1	2	3	4	5	6	7
2. The mathematics/science content was appropriate for the developmental levels of the students in this class.	1	2	3	4	5	6	7
3. Students were intellectually engaged with important ideas relevant to the focus of the lesson.	1	2	3	4	5	6	7
4. Teacher-provided content information was accurate.	1	2	3	4	5	6	7
5. The teacher displayed an understanding of mathematics/science concepts (e.g., in his/her dialogue with students).	1	2	3	4	5	6	7
6. Mathematics/science was portrayed as a dynamic body of knowledge continually enriched by conjecture, investigation analysis, and/or proof/justification.	1	2	3	4	5	6	7
7. Elements of mathematical/science abstraction (e.g., symbolic representations, theory building) were included when it was important to do so.	1	2	3	4	5	6	7
8. Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts.	1	2	3	4	5	6	7
9. The degree of "sense-making" of mathematics/science content within this lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.	1	2	3	4	5	6	7
10. _____	1	2	3	4	5		

B. Synthesis Rating

1	2	3	4	5
Mathematics/science content of lesson not at all reflective of current standards for mathematics/science education				Mathematics/science content of lesson extremely reflective of current standards for mathematics/science education

C. Supporting Evidence for Synthesis Rating

IV. Classroom Culture

A1. Ratings of Key Indicators

	Not at all				To a great extent	Don't know	N/A
1. Active participation of all was encouraged and valued.	1	2	3	4	5	6	7
2. There was a climate of respect for students' ideas, questions, and contributions.	1	2	3	4	5	6	7
3. Interactions reflected collegial working relationships among students (e.g., students worked together, talked with each other about the lesson).	1	2	3	4	5	6	7
4. Interactions reflected collaborative working relationships between teacher and students.	1	2	3	4	5	6	7
5. The climate of the lesson encouraged students to generate ideas, questions, conjectures, and/or propositions.	1	2	3	4	5	6	7
6. Intellectual rigor, constructive criticism, and the challenging of ideas were evident.	1	2	3	4	5	6	7
7. _____	1	2	3	4	5		

A2. Respect for Diversity

Based on the culture of a classroom, observers are generally able to make inferences about the extent to which there is an appreciation of diversity among students (e.g., their gender, race/ethnicity, and/or cultural background). While direct evidence that reflects particular sensitivity or insensitivity toward diversity is not often observed, we would like you to document any examples you do see. If any examples were observed, please check here ☐ and describe below:

B. Synthesis Rating

1	2	3	4	5
Classroom culture interfered with student learning				Classroom culture facilitated the learning of all students

C. Supporting Evidence for Synthesis Rating

V. Overall Ratings of the Lesson

A. Likely Impact of Instruction on Students' Understanding of Mathematics/Science

While the impact of a single lesson may well be limited in scope, it is important to judge whether the lesson is likely to help move students in the desired direction. For this series of ratings, consider all available information (i.e., your previous ratings of design, implementation, content, and classroom culture, and the pre- and post-observation interviews with the teacher) as you assess the likely impact of this lesson. Feel free to elaborate on ratings with comments in the space provided.

Select the response that best describes your overall assessment of the *likely effect* of this lesson in each of the following areas.

	Negative effect		Mixed or neutral effect		Positive effect	Don't know	N/A
1. Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation.	O	O	O	O	O	O	O
2. Students' understanding of important mathematics/science concepts.	O	O	O	O	O	O	O
3. Students' capacity to carry out their own inquiries.	O	O	O	O	O	O	O
4. Students' ability to apply or generalize skills and concepts to other areas of mathematics/science, other disciplines, and/or real-life situations.	O	O	O	O	O	O	O
5. Students' self-confidence in doing mathematics/science.	O	O	O	O	O	O	O
6. Students' interest in and/or appreciation for the discipline.	O	O	O	O	O	O	O

Comments (optional):

B. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is *not* intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

O **Level 1: Ineffective Instruction**
There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is *highly unlikely* to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. Lesson was characterized by either (select one below):

O **Passive "Learning"**
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.

O **Activity for Activity's Sake**
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

O **Level 2: Elements of Effective Instruction**
Instruction contains some elements of effective practice, but there are *serious problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *very limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.

O **Level 3: Beginning Stages of Effective Instruction** (Select one below.)
O Low 3 O Solid 3 O High 3
Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *weaknesses*, ranging from substantial to fairly minor, in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science.

O **Level 4: Accomplished, Effective Instruction**
Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science.

O **Level 5: Exemplary Instruction**
Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is *highly likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" mathematics/science.

Please provide your rationale for the capsule rating:

APPENDIX E

INTERVIEW PROMPTS

Interview Prompts:

(alignment to research questions indicated by number)

If you don't have any objections I would like to tape this interview.

If at anytime you feel uncomfortable with a question or the interview you just let me know and we can move on or conclude the interview.

I have a couple of questions I would like to ask about you school and your teaching. But first do you have any questions for me?

Sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way.

1. Thinking about your teaching situation what influences how you teach science? (1, 2, 3)
    a. In your school, do you decide what to teach and what not to teach? (1, 2, 3)
    b. Sometimes other people in the school and district can influence your teaching
        1) Does your principal have any influence on your choice of lesson(s) or how you teach? (1, 2, 3)
        2) Other teachers in the school?
        Parents/community?
        School board?
        District administration?
        National policy or rules?
        Anyone else?

2. What do you feel drives the amount of time you teach a specific content? (1, 2, 3)
3. How do you decide what to teach and what not to teach in your science classes? (2, 3)
4. How have you adapted your teaching to meet local, state, and national mandates? (2, 3)
5. How do you maximize student learning in your classroom? (3)
6. How do you describe your role as a teacher? (3)
7. How do you know when your students understand? (3)
8. How do you decide when to move on to a new topic in your classroom? (1, 2, 3)
9. How do your students learn science best? (3)
10. How do you adapt you teaching to best represent science concepts to your students? (3)

11. What instructional strategy do you feel most comfortable using? (3)
12. What opportunities have you had to learn about different instructional strategies? (3)
13. Were the opportunities required or encouraged by the district? (3)
14. How helpful were they? (3)

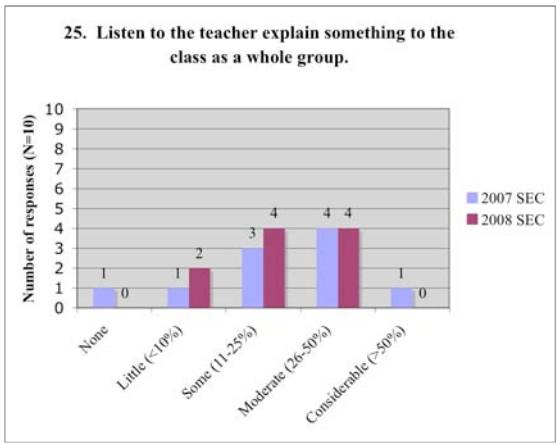
Thank you for your time. I will be sending you a copy of the transcript to look over and make sure that I represented your responses correctly.

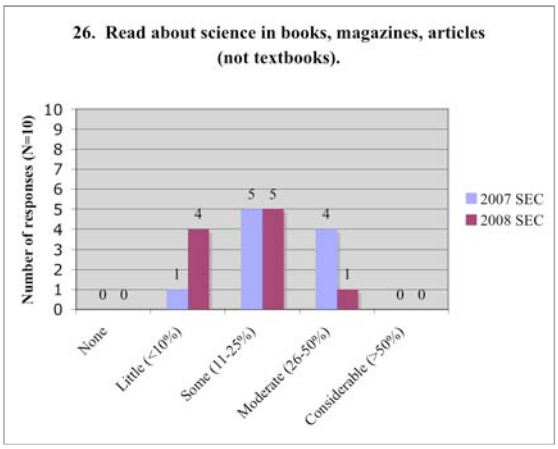
APPENDIX F

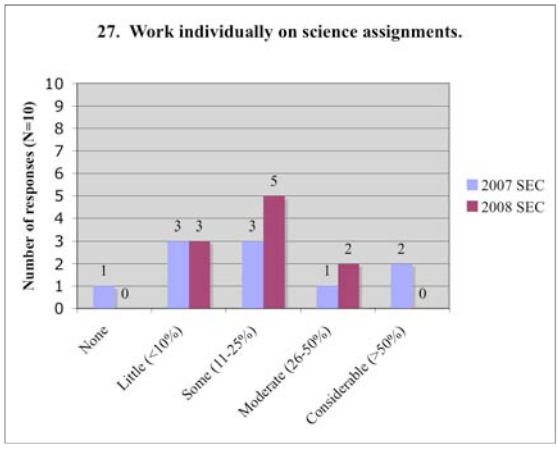
2007 AND 2008 SEC GRAPHICAL RESULTS

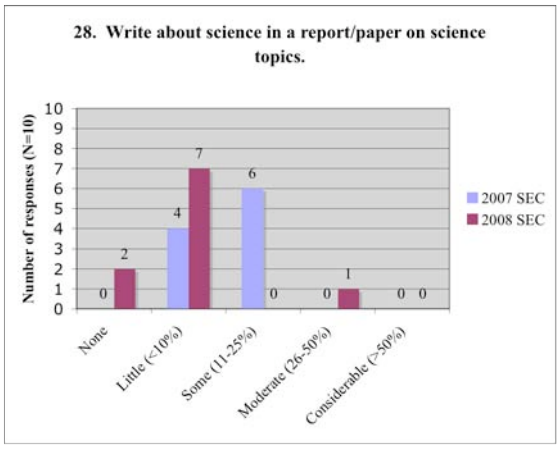
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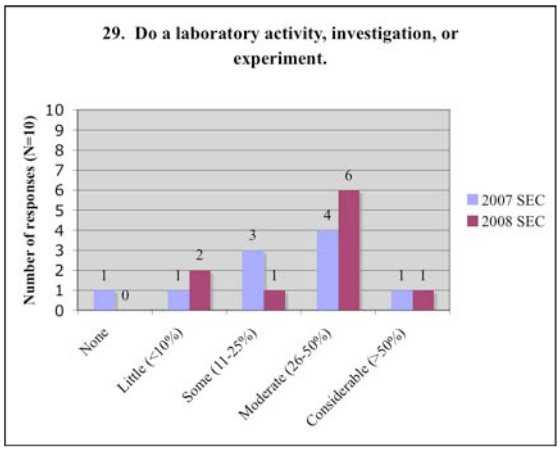
Amount of instructional time for types of activities students engage in during science instruction for the school year. How much of the total science instructional time do students engage in:

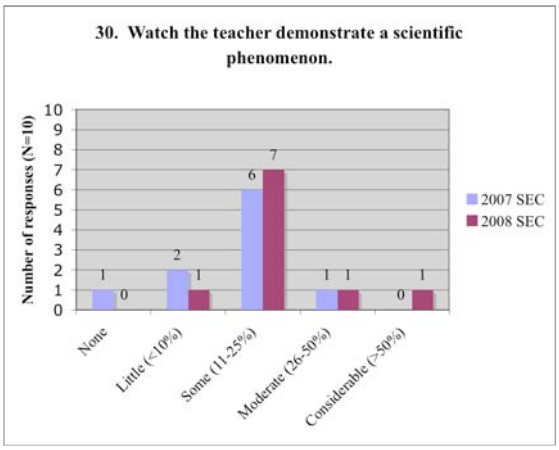




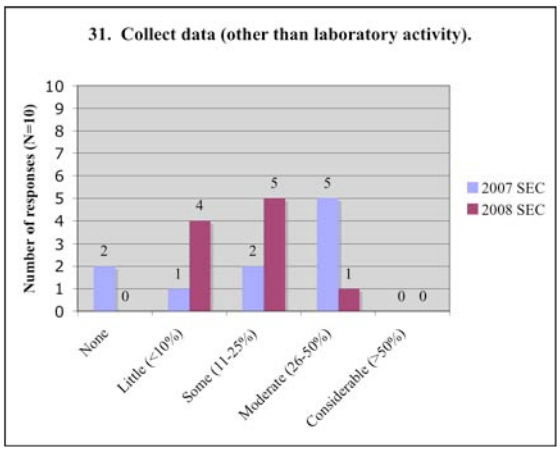


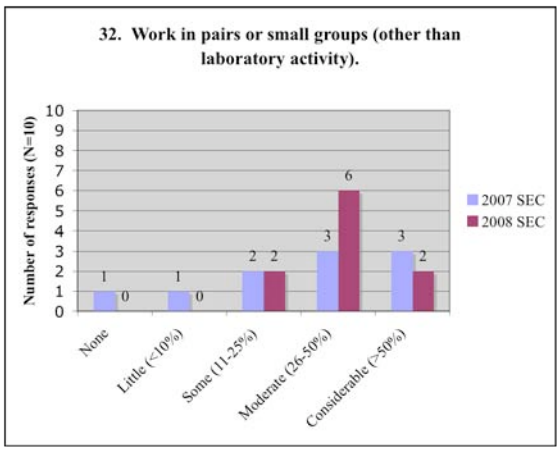


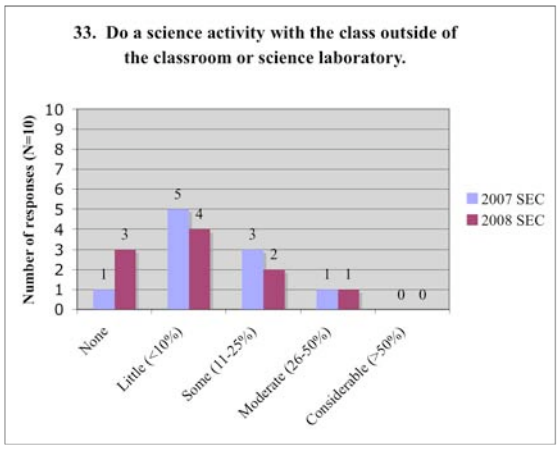


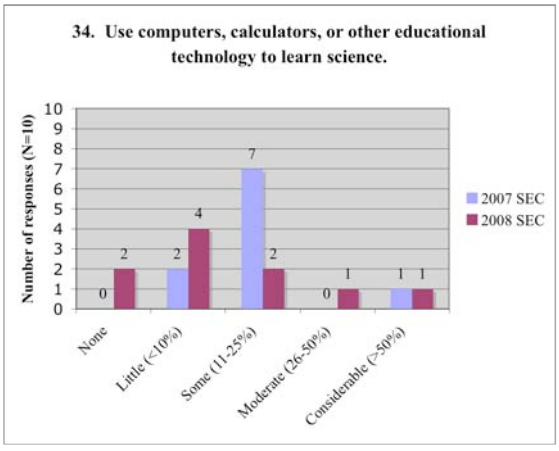


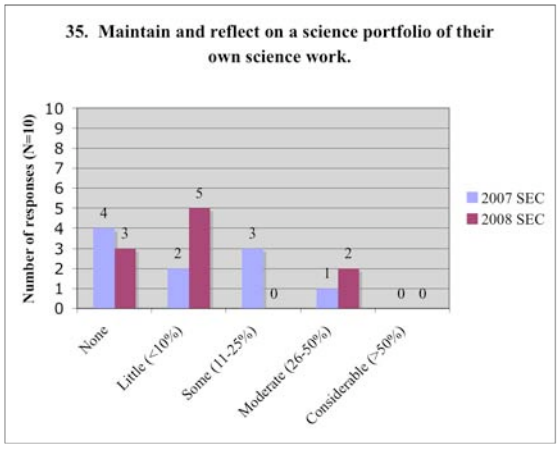
Amount of instructional time for types of activities students engage in during science instruction for the school year. How much of the total science instructional time do students engage in (continued):

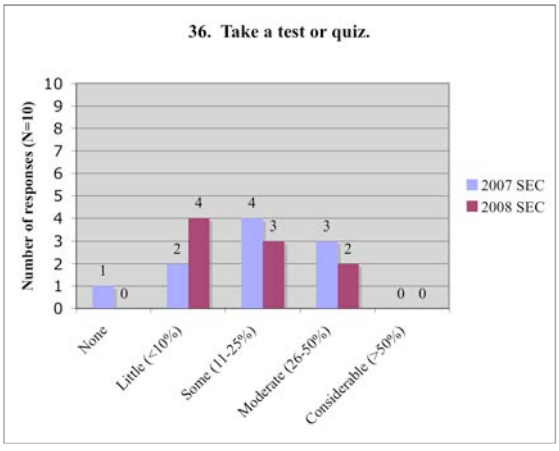




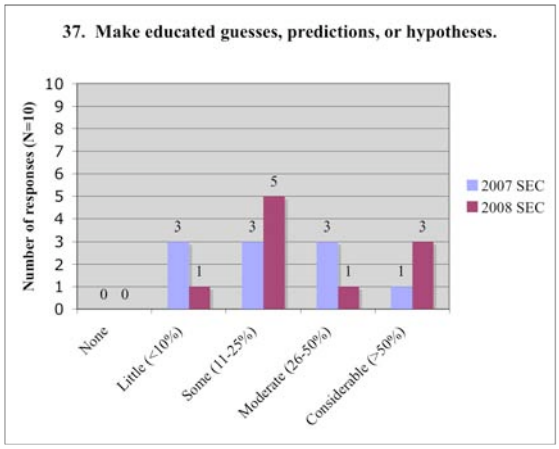


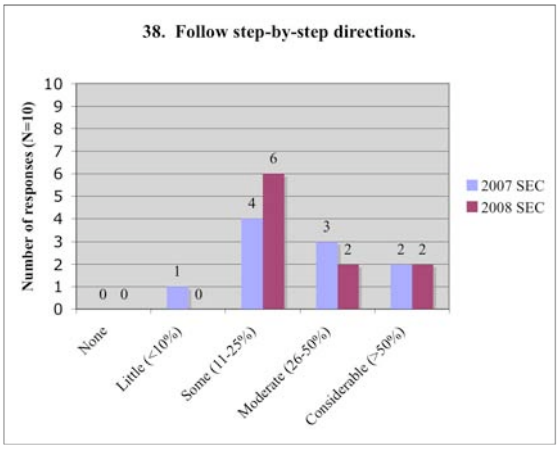


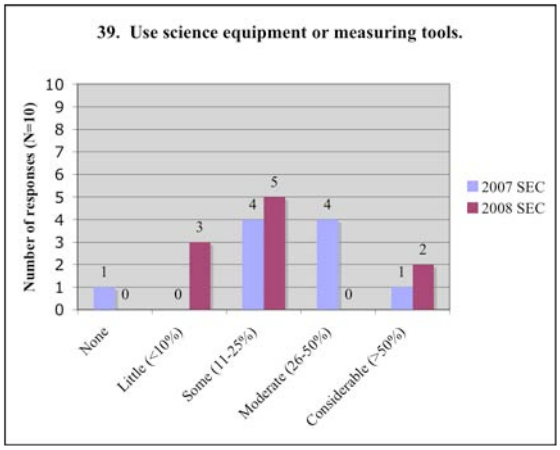


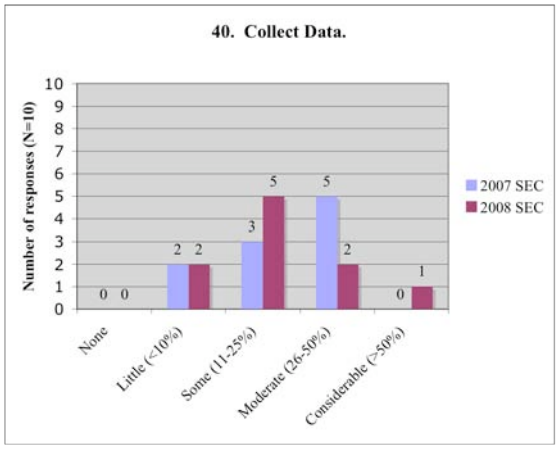


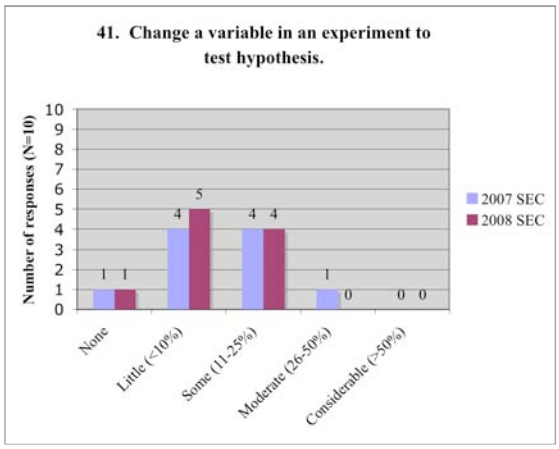
When students in the target class are engaged in laboratory activities, investigations or experiments as part of science instruction, how much time do they:

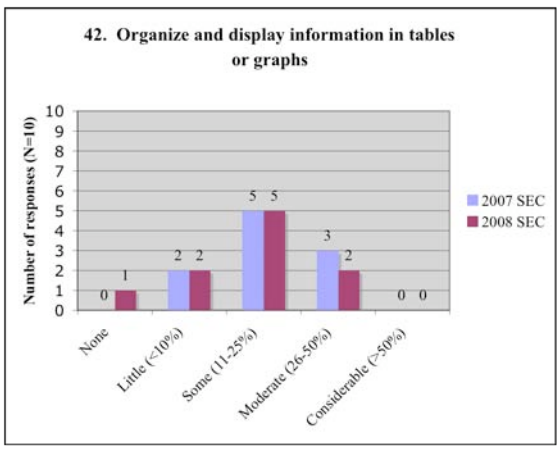




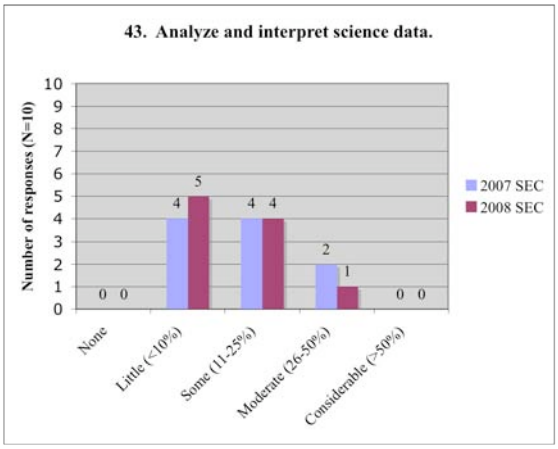


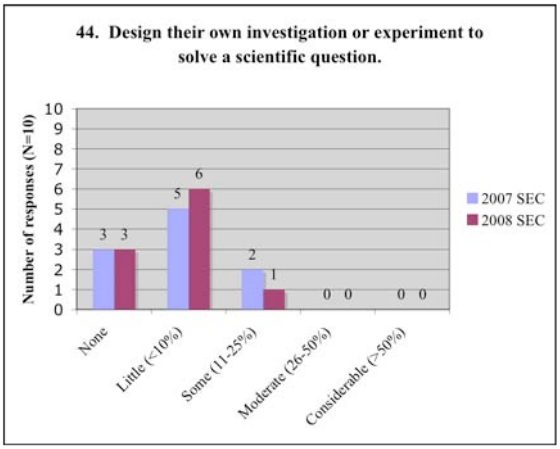


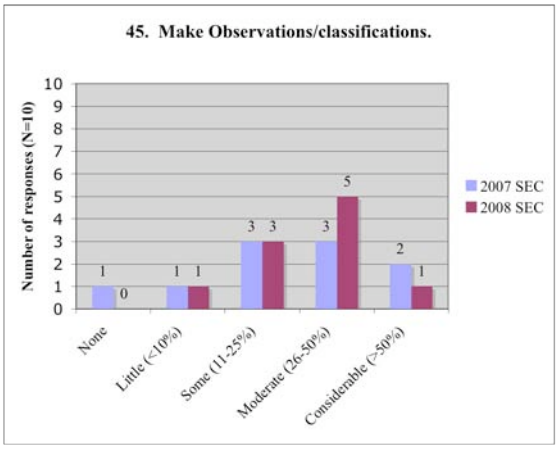




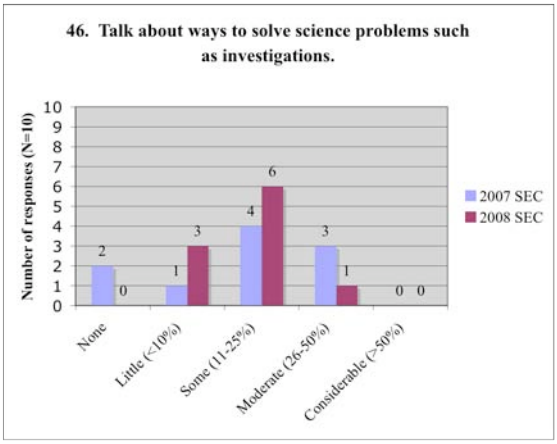
When students in the target class are engaged in laboratory activities, investigations or experiments as part of science instruction, how much time do they (continued):

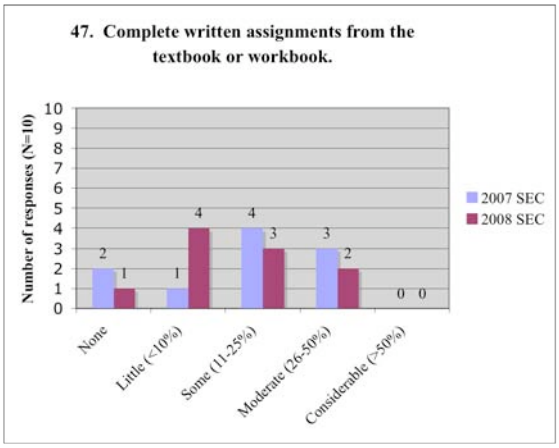




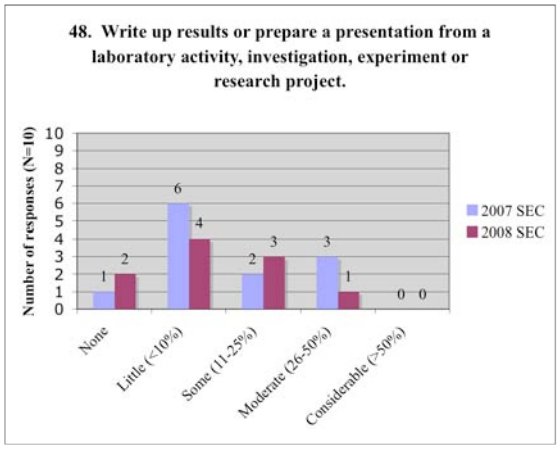


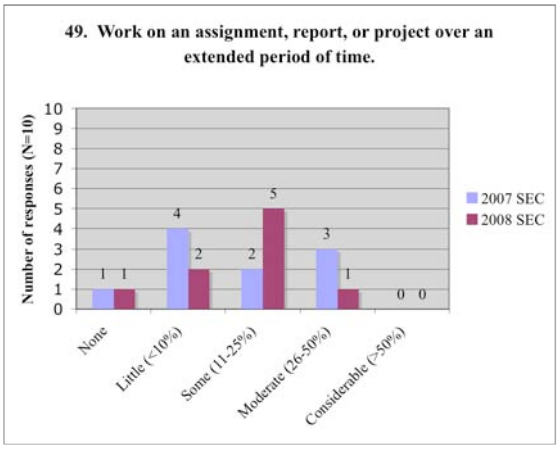
When students in the target class work in pairs or small groups (other than in the science laboratory), how much time do they:

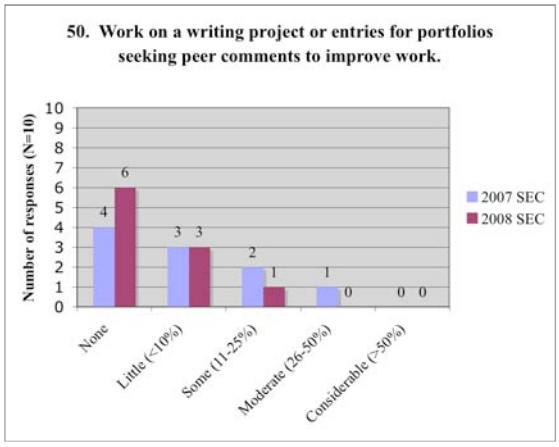


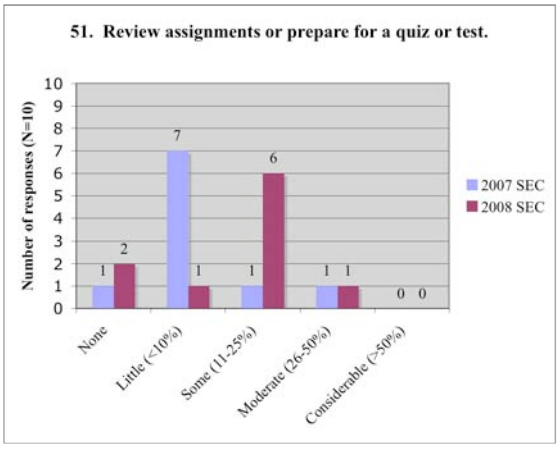


When students in the target class work in pairs or small groups (other than in the science laboratory), how much time do they (continued):

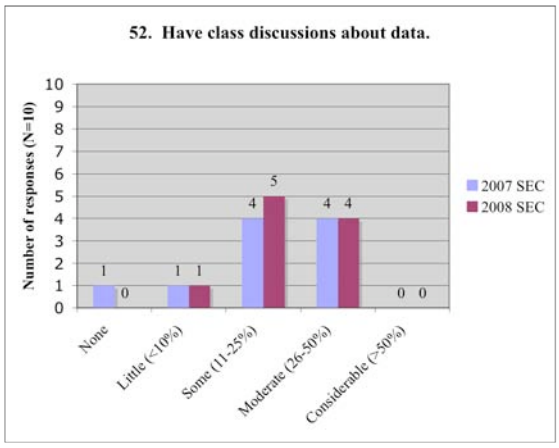


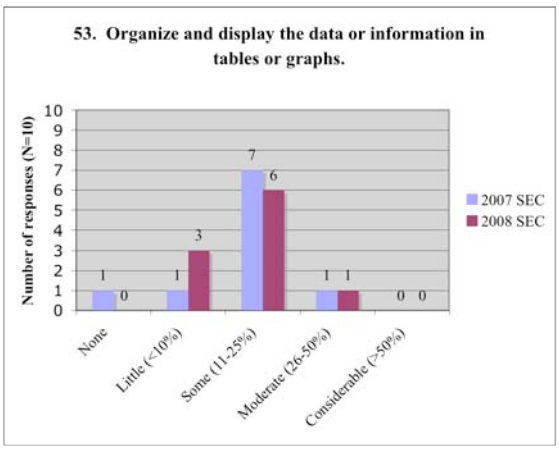


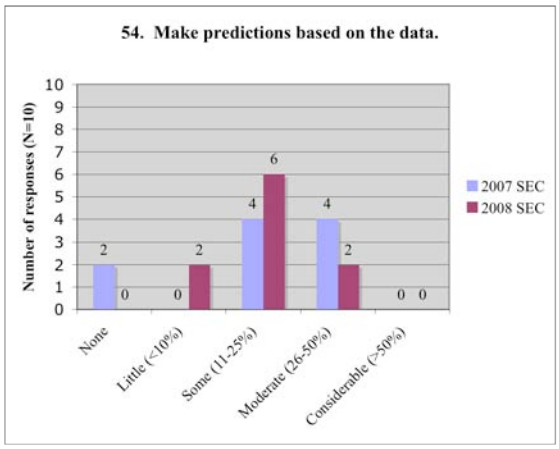


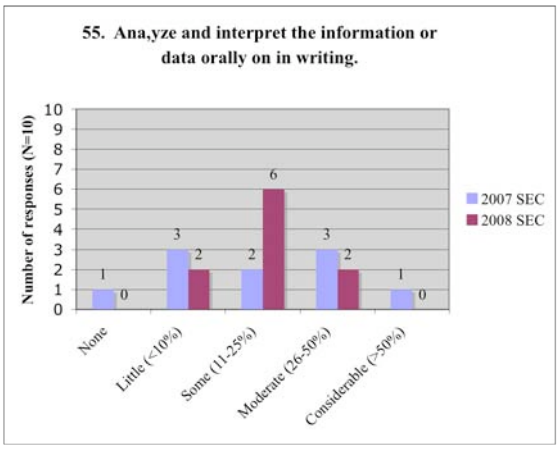


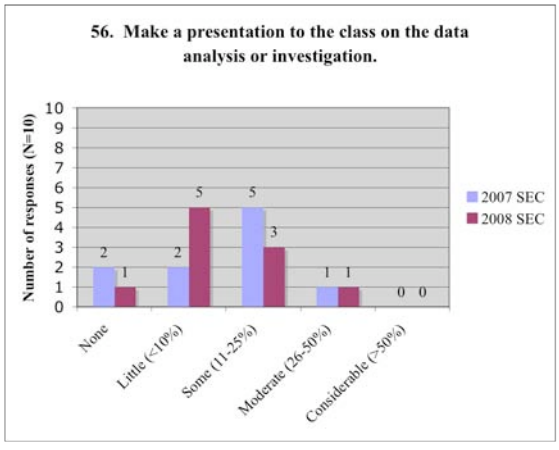
When students in the target class collect science data or information from books, magazines, computers, or sources (other than laboratory activities), how much time do they:



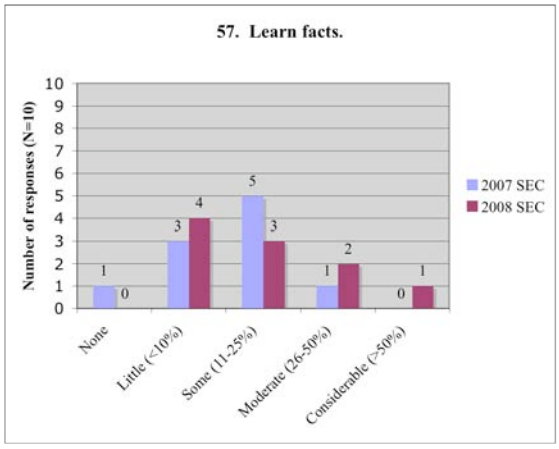


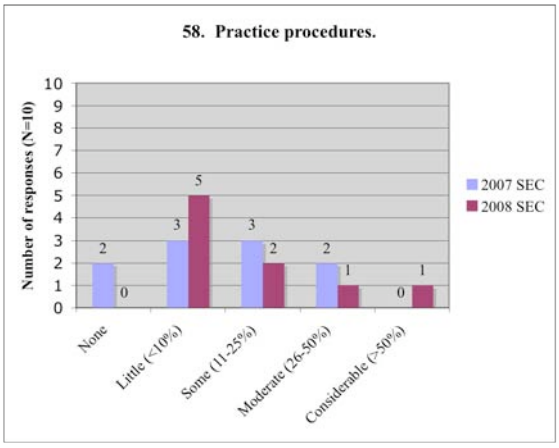


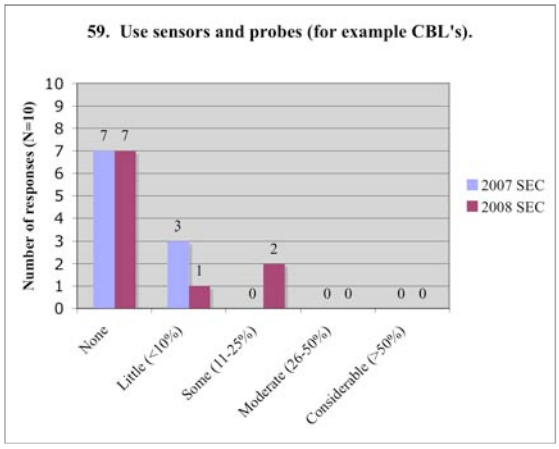


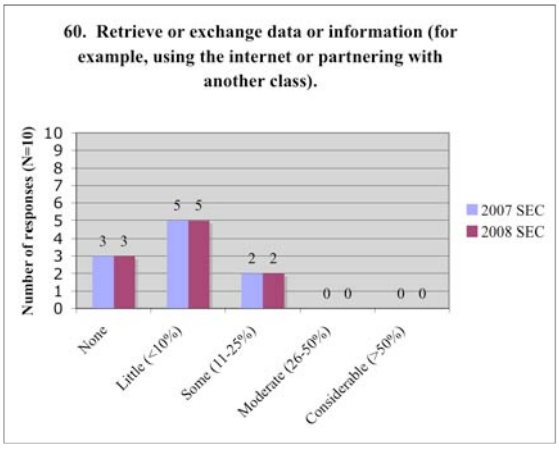


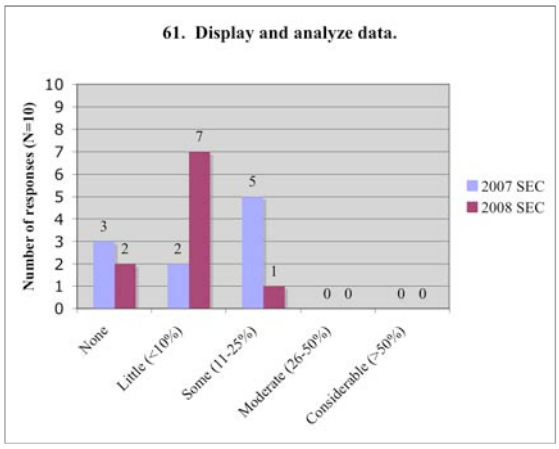
When students in the target class are engaged in activities that involve the use calculators, computers or other educational technology as part of the science instruction, how much time do they:

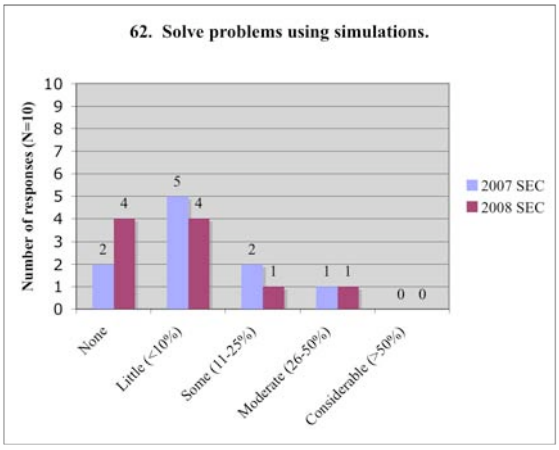




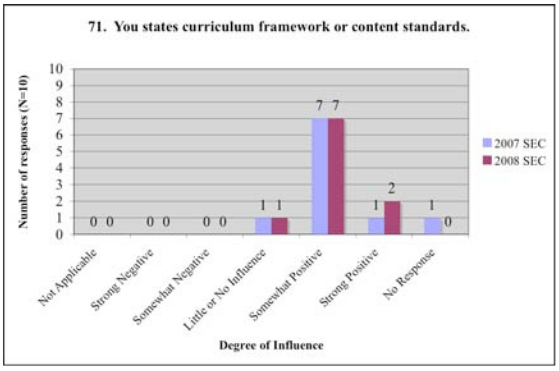


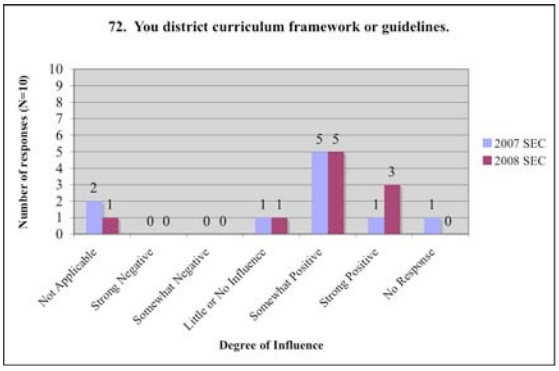


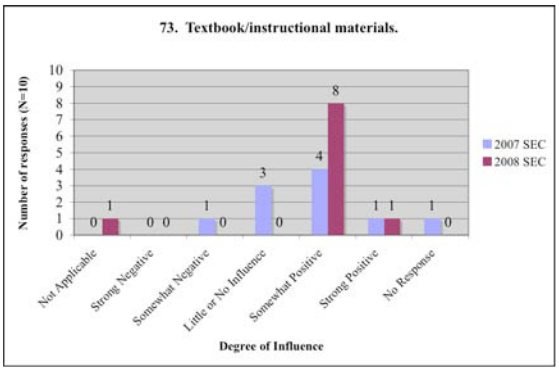


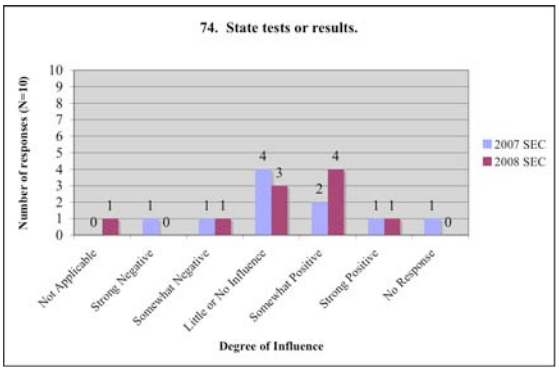


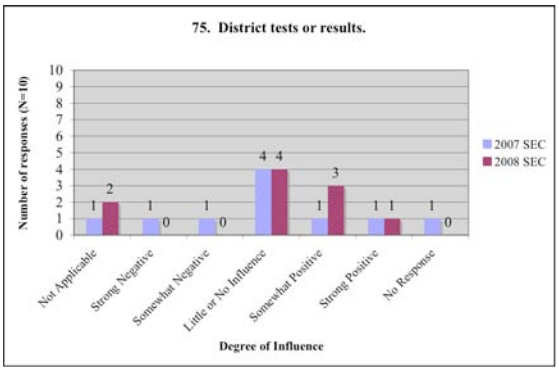
Indicate the degree to which each of the following influences what you teach in the target science class.

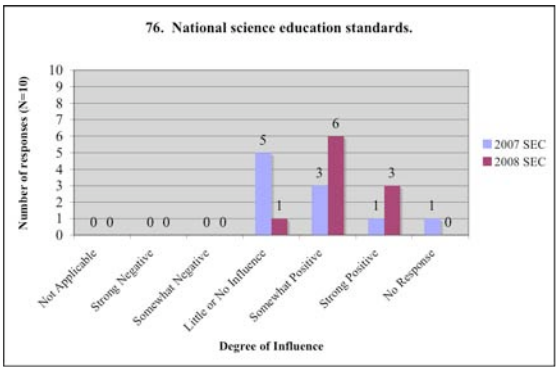


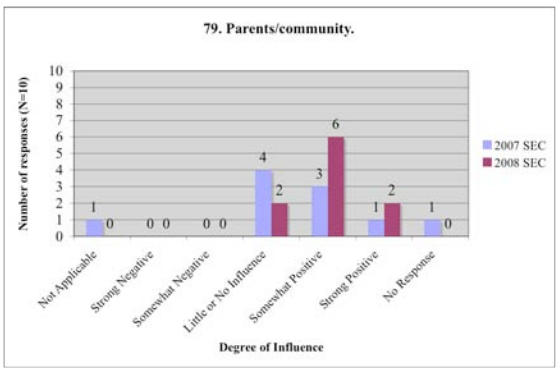










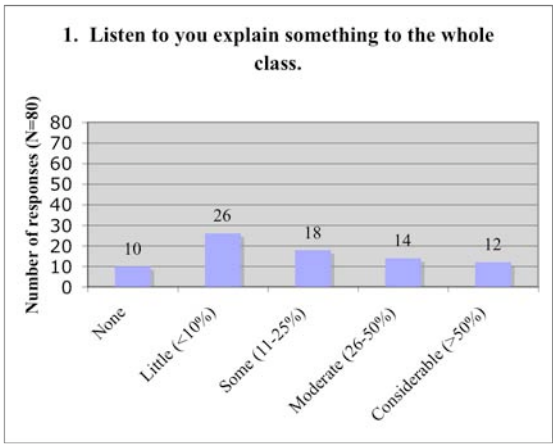


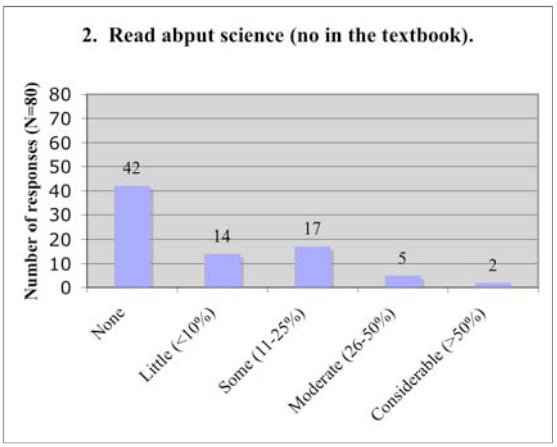
APPENDIX G

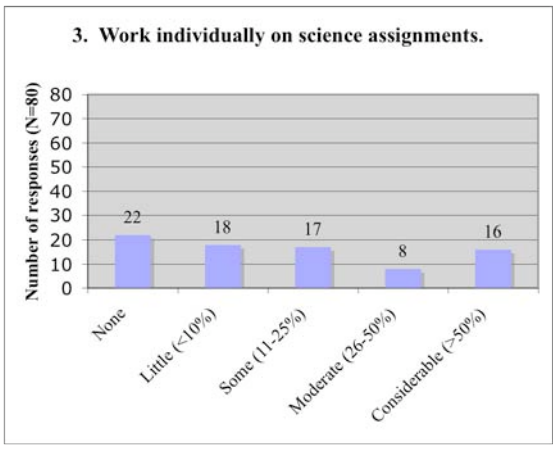
2008 WTS GRAPHICAL RESULTS QUESTIONS 1 – 24 AND REFLECTIVE RESPONSES

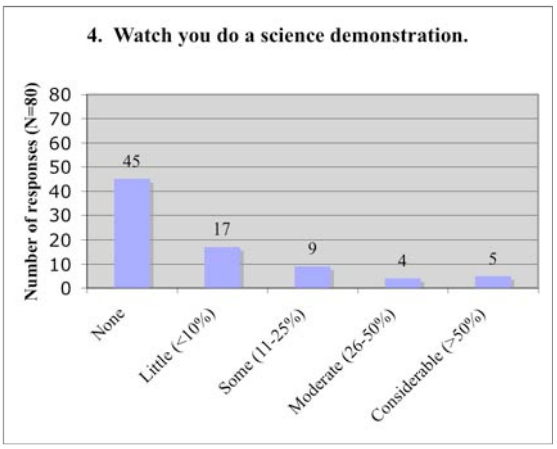
2008 WTS Graphical Results

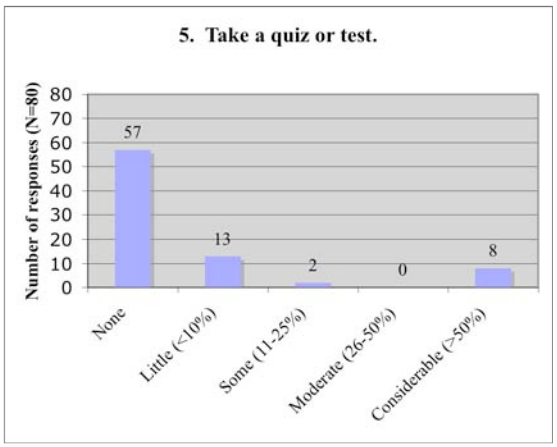
Answer the following questions regarding your science teaching this week. Did your students:



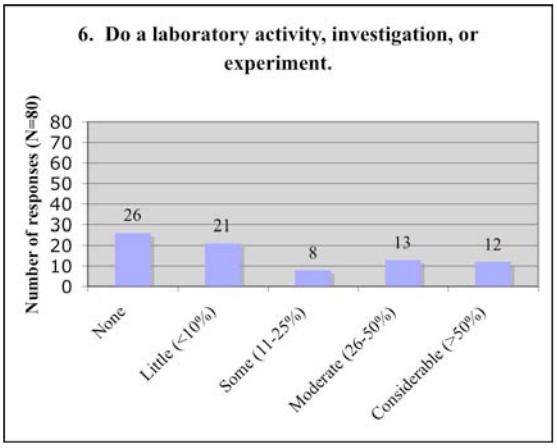


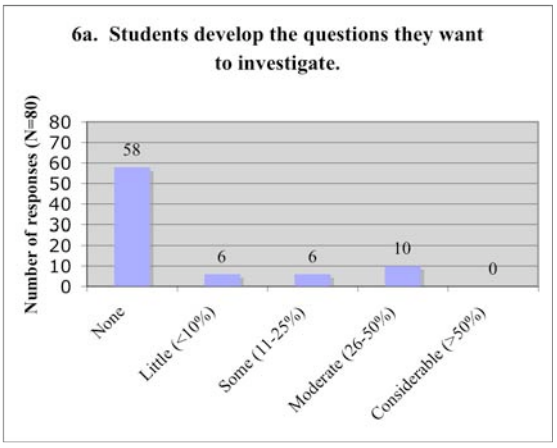


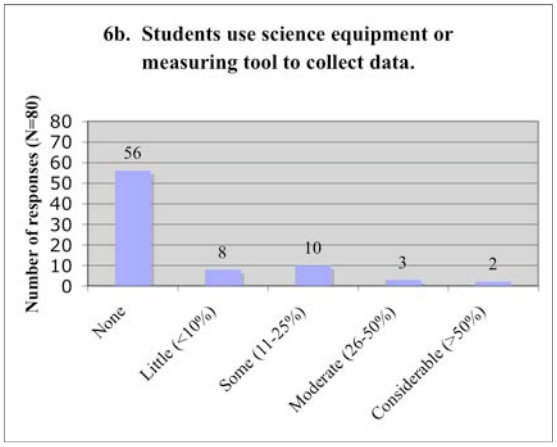


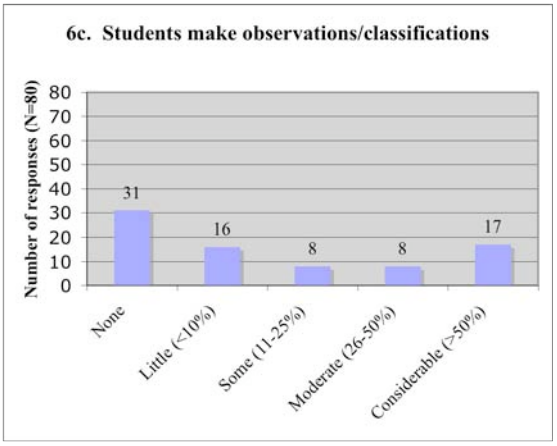


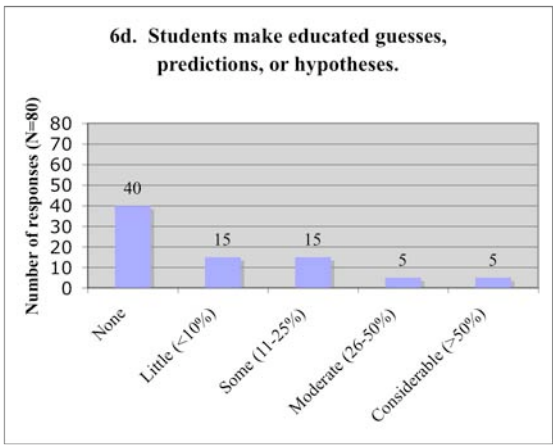
Question 6 and sub questions addressing activities during lab, investigation, or experiment.

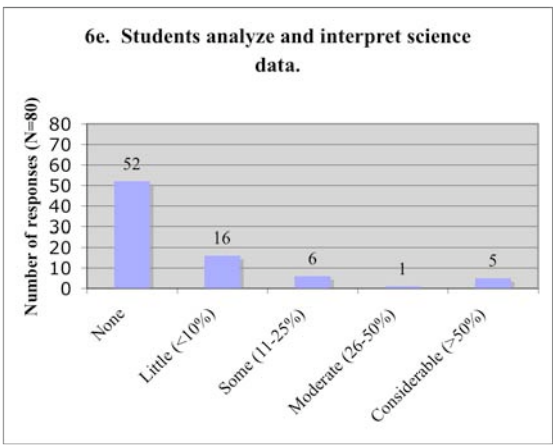




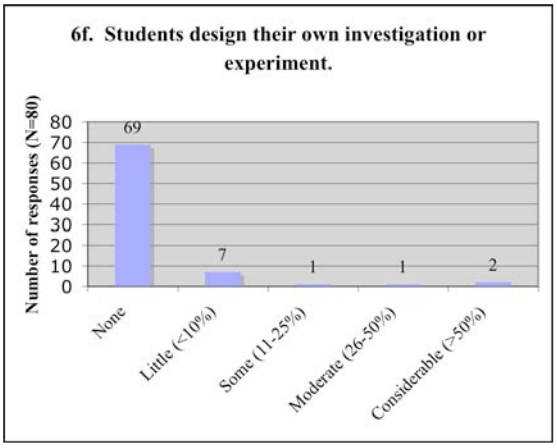


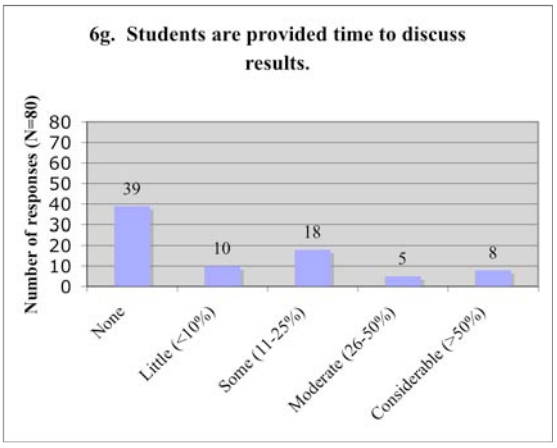


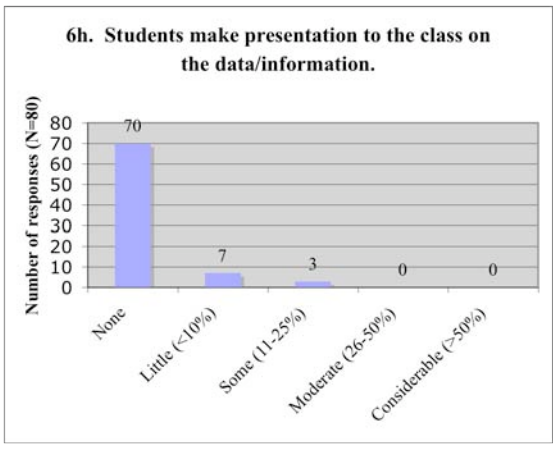




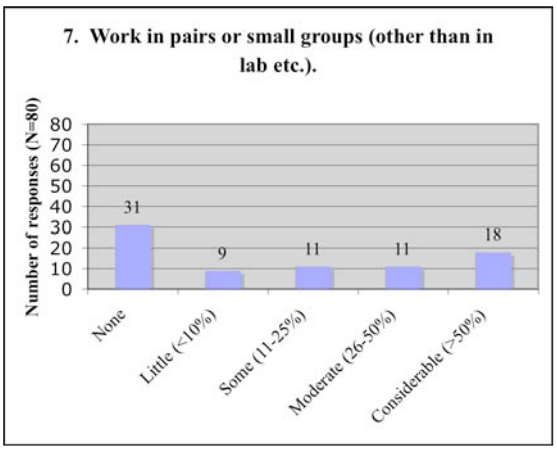
Question 6 and sub questions addressing activities during lab, investigation, or experiment (continued).

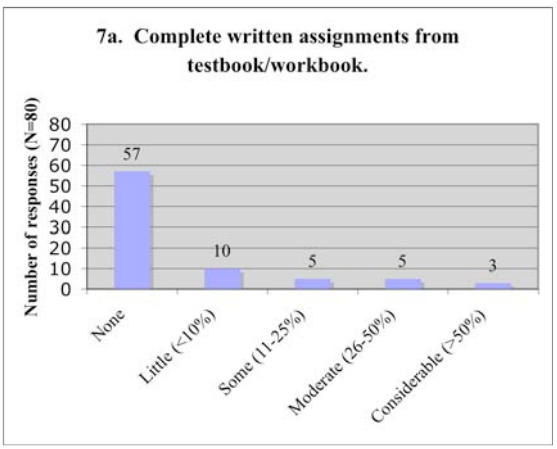




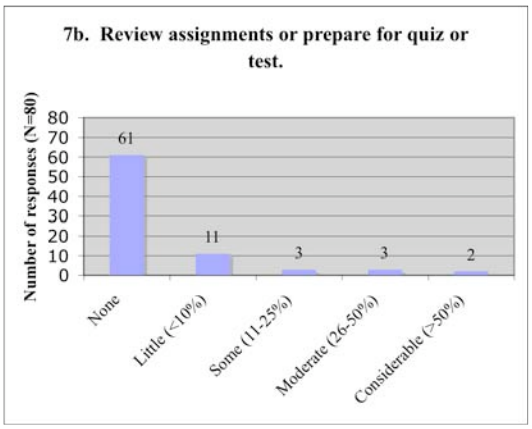


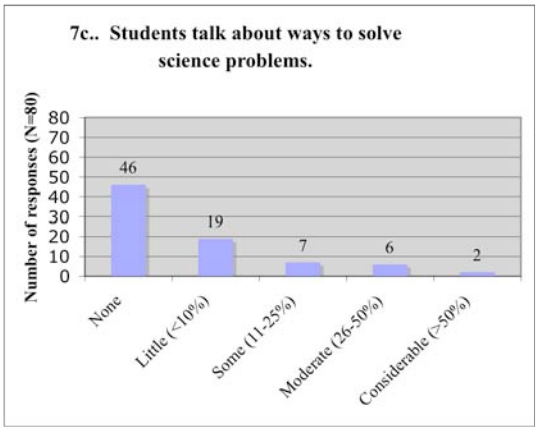
Question 7 and sub questions addressing activities during pair and small group work.

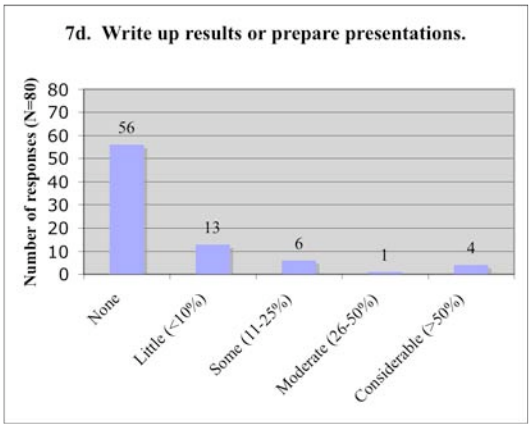


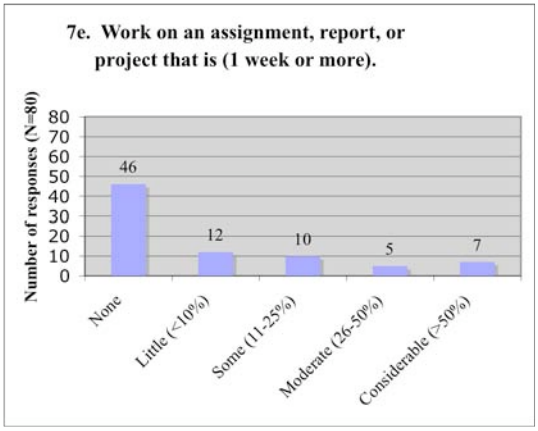


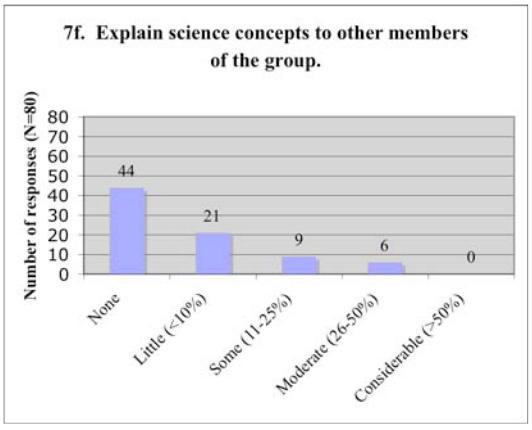
Question 7 and sub questions addressing activities during pair and small group work (continued).



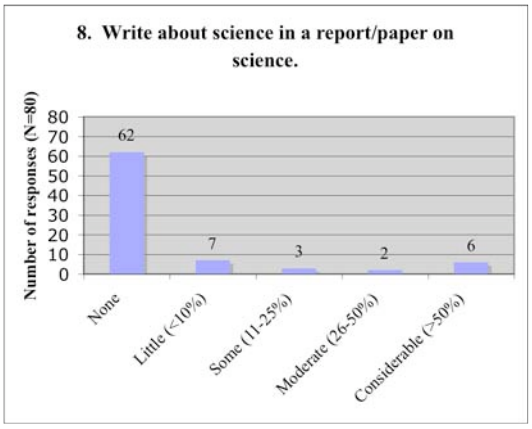


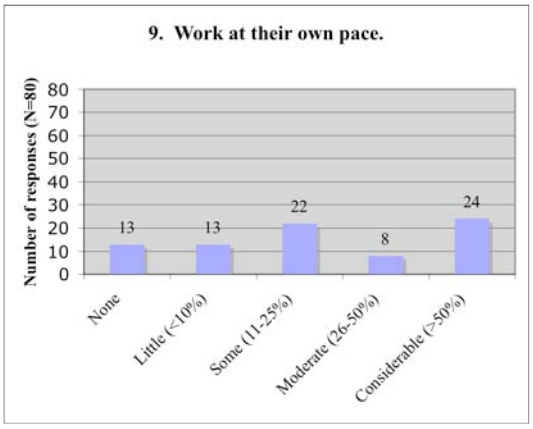


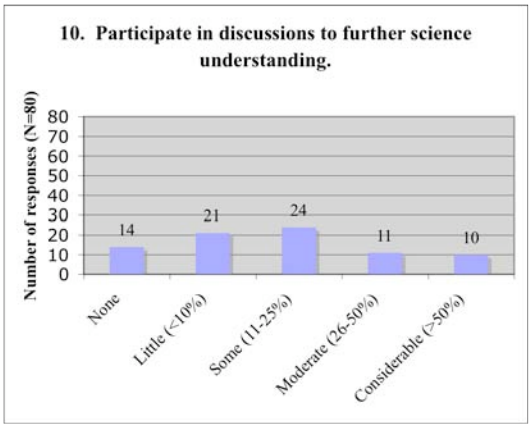


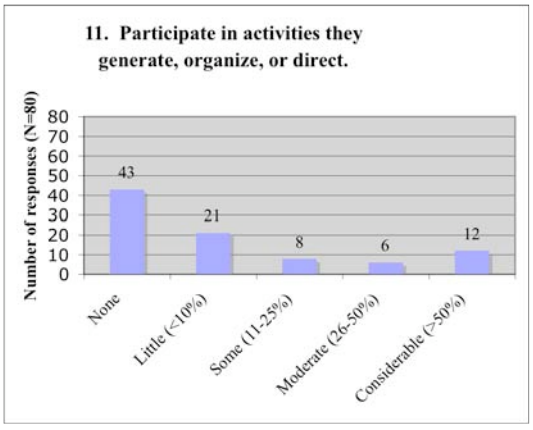


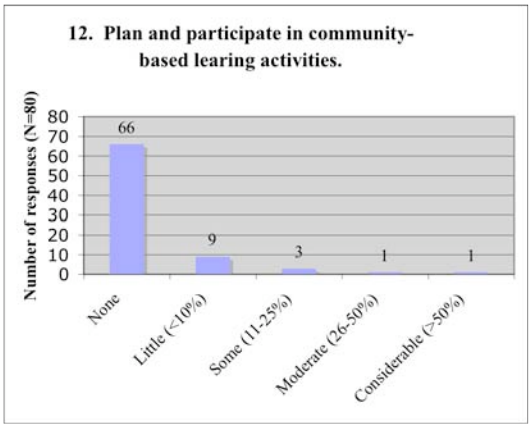
Questions 8 – 12: Answer the following questions regarding your science teaching this week. Did your students:



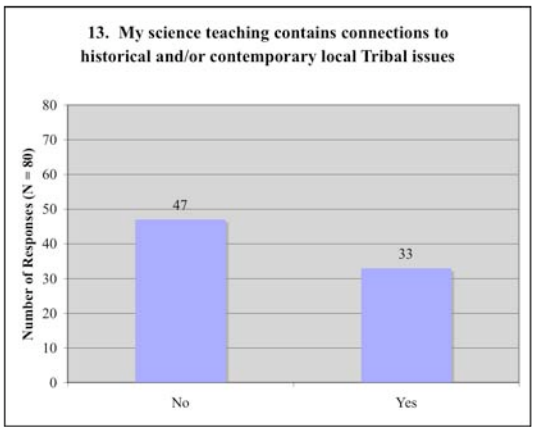


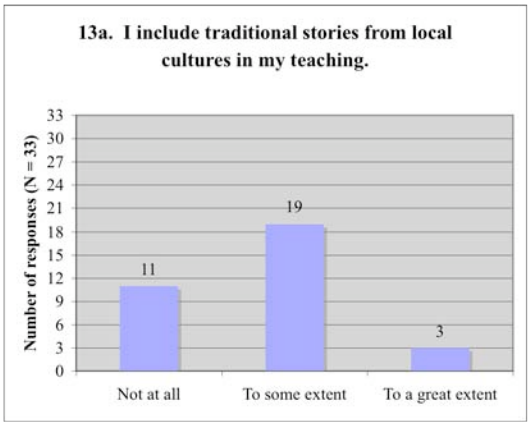


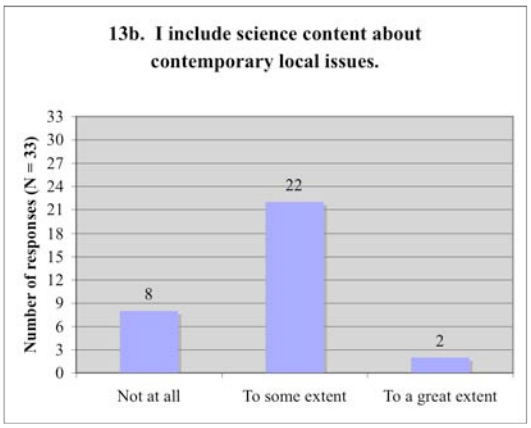


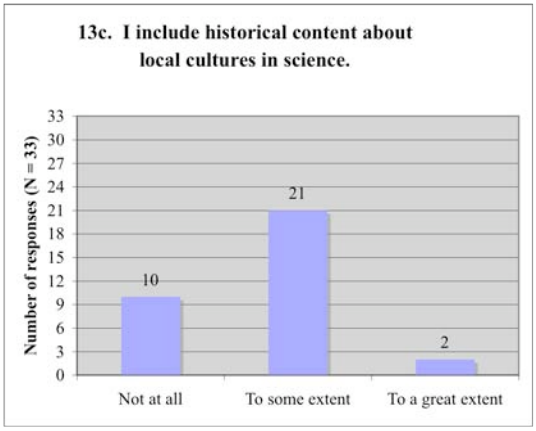


Question 13 and sub questions addressing activities related to historical and contemporary local Tribal issues. Readers please note that 13a – 13d are based on N =33 for the weeks when teachers indicated that they did address local Tribal issues.



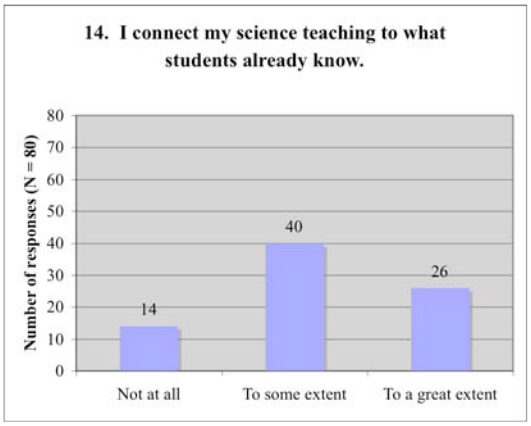


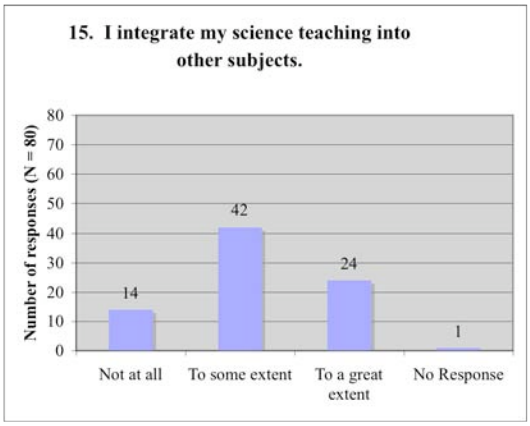


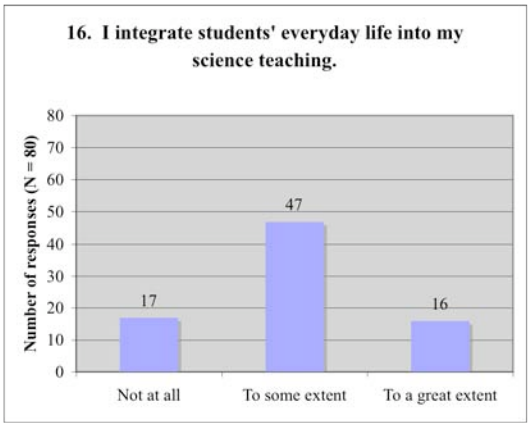


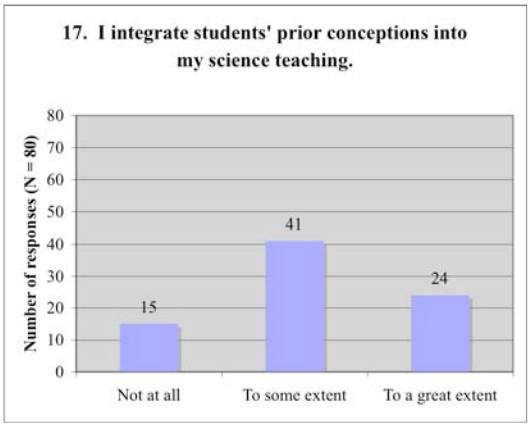


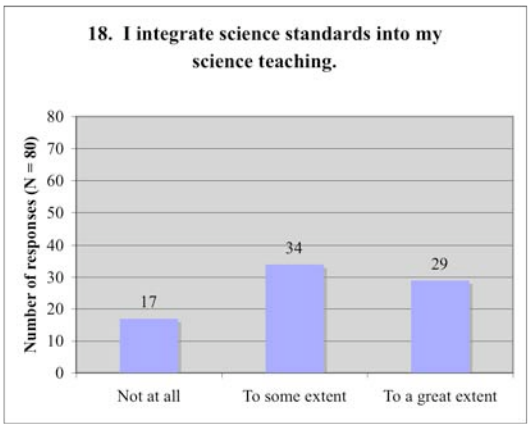
Questions 14 – 18: Reflecting back on your science teaching this week, please respond to the following statements:



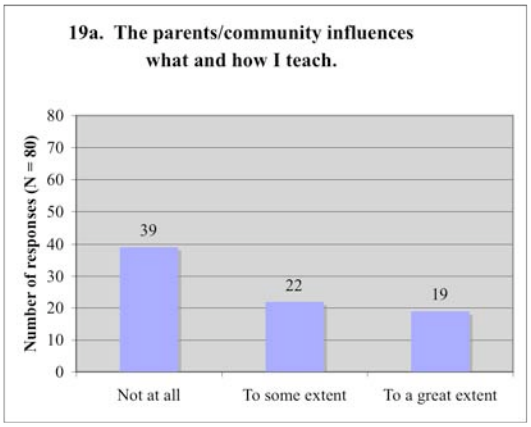


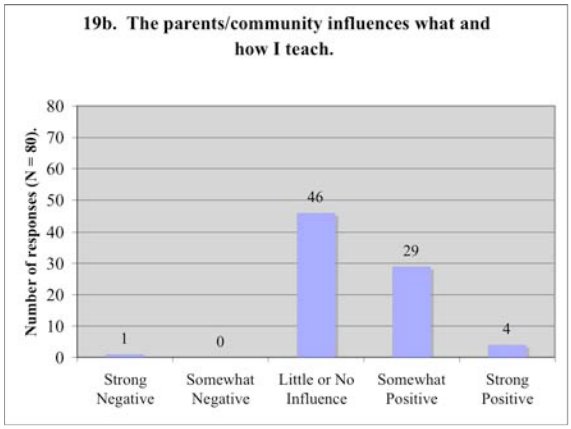


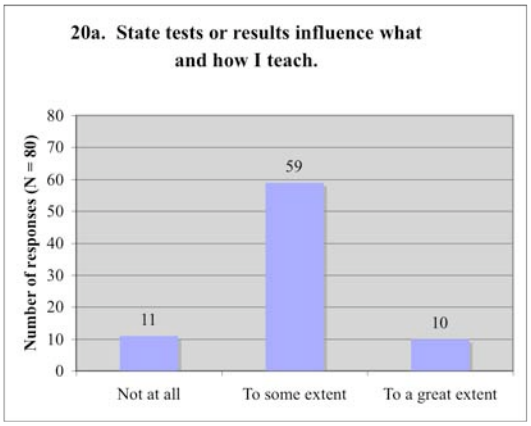


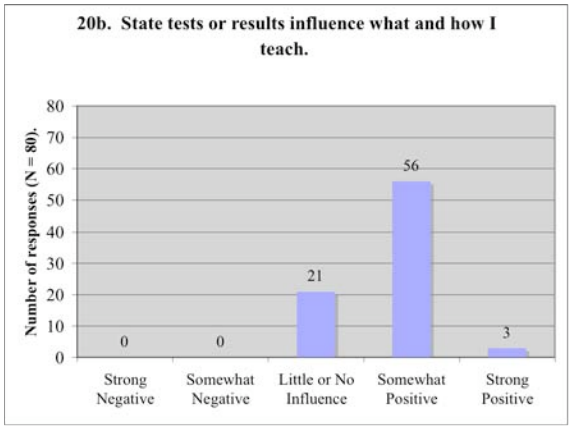


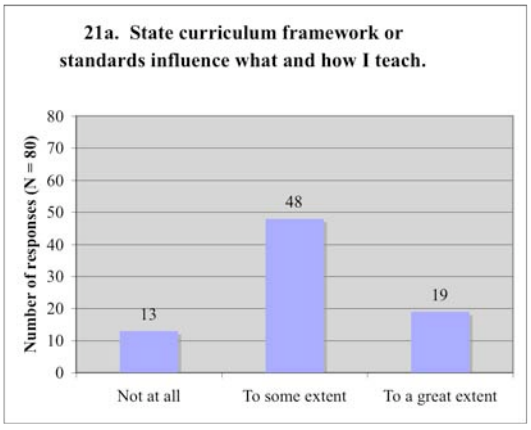
Questions 19 through 24: Each question has two graphs that represent responses to both the extent of the influence and the degree of the influence.

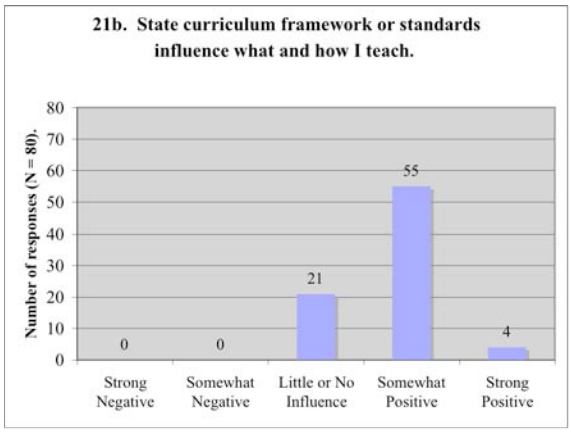




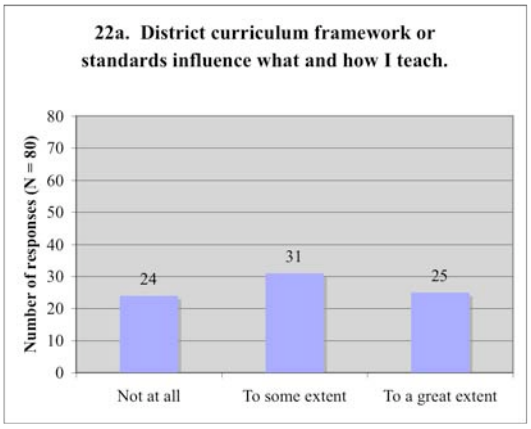


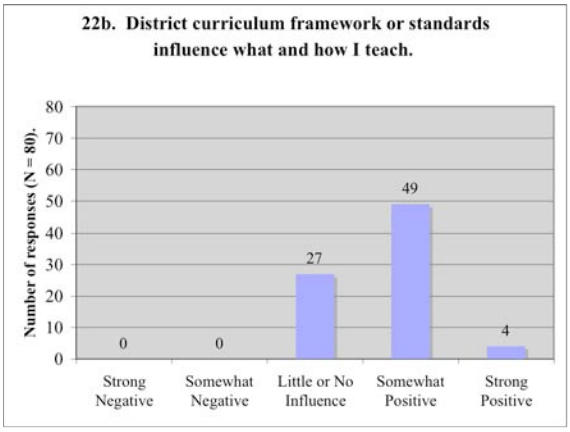


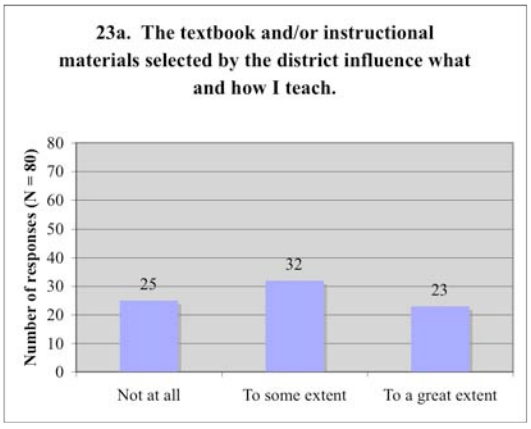


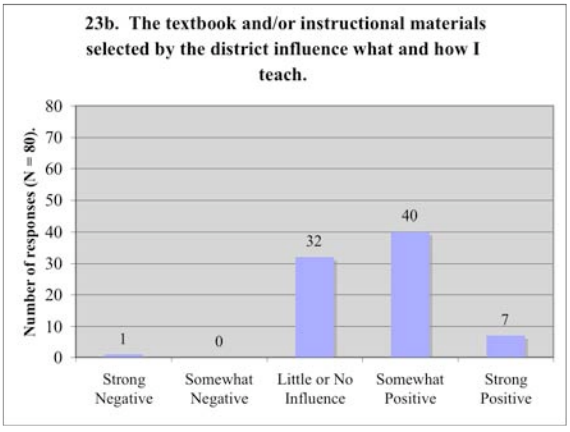


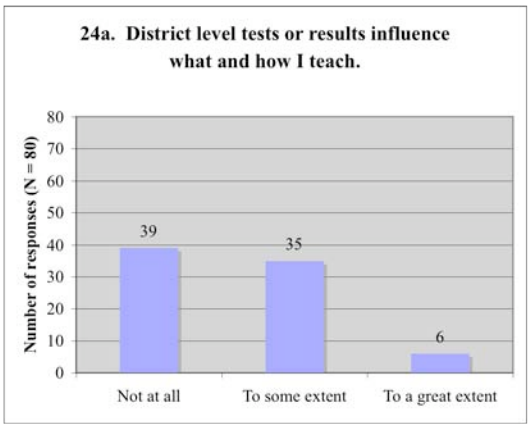
Questions 19 through 24: Each question has two graphs that represent responses to both the extent of the influence and the degree of the influence (continued).

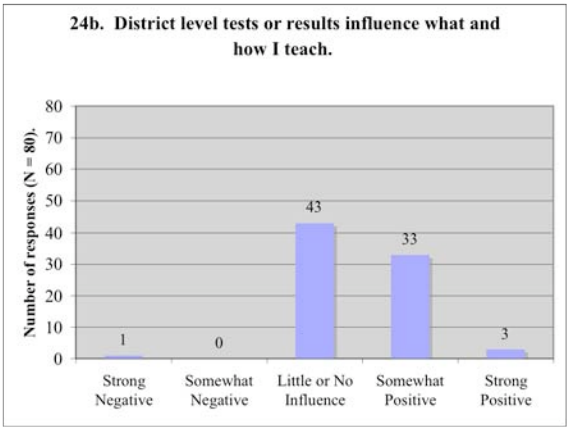












Question 25: Reflective Response

Reflection Comments "Jessica":

W1:
This week we studied about the earth & the sun. The Earth's rotation, climate, seasons, how animals migrate, the poles, the equator & facts on geese. Vocabulary this week: Migration, equator, poles

W2:
No Comments

W3:
We had MontCast testing for 3 days this week.

W4:
We began a unit on Tornadoes.

W5:
Everything I do is correlated with our reading materials

W6:
No Reflections this week

W7:
No Reflections this week

W8:
No Reflections this week

Reflection Comments "Kimberly":

W1:
No Comments

W2:
This week I worked with a small group of my students making paper models of various crystal forms. We started with the cube from because we had done a project making salt crystals. Then we are slowly making our way through the other forms of crystals. When possible I am trying to show the students' samples of the crystals found in the natural setting. The students are enjoying this project and the crystal models are coming out very well--- with each crystal the students are having to write a the name of the crystal in the natural world as well on the model (ie cub=halite/salt, hexagonal prism=quartz, tetrahedron=chalcopyrite (for my students I say that it is a copper mineral). It has been

Reflection Comments “Kimberly” (continued):

interesting with the discussion that takes place as the students work on their projects independently yet in a small group.

W3:
The district that I am in does not do district wide testing any more except doing the state CRT testing. I do not use a science textbook -- rather I am bound to my student's I.E.P., s for my teaching. I am currently using science materials as a high interrest way to get my students to want to learn to rad and to learn new and different vocabulary words that they will encounter all through their time in the public education system -- I have found in the past that connecting students to science has encouraged them to read because of the variety of interests that science has for students to encounter.

This week I used the National Geographic Young Explorer magazine to introduce life science vocabulary to my students through a small group discussion about "habitats". The students were then introduced to the vocabulary word "flow charting". (could possibly be termed as "concept mapping") as I demonstrated how to develop a "flow chart". The students then made a flow chart showing the information they learned about a variety of habitats that we talked about during the session. For a first time effort with flow charts, the students did well.

W4:
This week the students finished their models of the various shapes of crystals aout of paper. I used a lesson plan with modifications for my sudents from a lesson in the book that dealt wih rocks that we received this last summer. The students enjoyed making the models and were challenging each other on which model was the most difficult to make. I think they agreed that the pyritohedron model was the most difficult to make. I had them write on the model the name of the crystal as it is found in the natural world (ie cube=table salt, pyritohedron=fool's gold etc.). I hope to be able to show my students samples from the natural world of all the crystal shapes though there are a few that because of the difficulty of finding them I won't be able to do. The students also made a chart which gave the shape of the crystal, how it is found in the natural world and how many faces the crystlal has. The chart is just to give them aanother way of organizing data collected of information collected. This experience went well.

W5:
The science lesson focused on the life cycle of a butterfly. The students read an article in National Geographic Young Explorer magazine and then worked on worksheets with group discussion as they worked to check for understanding. A purpose I had was to introduce new vocabulary (i.e. chrysalis, pupa) to students. An extension I would have like to do with students was to get a butterfly cycle gorwth kit and have students watch the cycle take place and then release butterflies outside in the field by the school.

Reflection Comments “Kimberly” (continued):

W6:
The science lesson focused on birds and eggs. Students read an article in National Geographic Young Explorer magazine and then worked on worksheets with group discussion as they worked to check for understanding of what was read. As a group discussion focused on similarities and differences between the birds pictured and their eggs too. The students were most impressed with the Emu. My focus was working with the students on the elements of compare and contrast. The students wer with these two concepts in their general education classes so I was reinfoecing what was being learned in general education. The students seemed to be grasping the concept of comparing and contrasting two things when they shared answers verbally.

W7:
This week I chose to do a serindipity sciecne lesson with a third grad class working with rock identification. Since I had share the volcanic rocks that Frankie gave us this month with the class in a previous session. This was an easy additional lesson. I created a worksheet with east to understand decriptions of the rock and mineral samples we recdelived last summer and handed them out to the students to work with as they looked at and examined the rocks for themselves. They then had to read the descriptions given and find the rock that fit the descrioptions. For a first time experience the students did really well---they get a class treat from me. One student commented during the time, "We're being real scientists aren't we!!!" I and the classroom teacher responded with an enthusiatic "YES!!". The cultural element was present when we discussed rocks that were good sweat rocks and rocks that made good arrowheads and rocks that gave us table salt, lead pencils and chalkboards. It was a fun experience!!!

Reflection Comments “Christina”:

W1:
At this time O am not sure what the district expects from the science taught in the classroom. We are going from not much to let’s teach the science book. I am sure it will be sorted out next year when we start curriculum mapping of science.

W2:
Please note this survey is for Feb-25-Feb-29. I was finishing my unit on earthquakes and volcanoes for the fifth grade. Third grade used the internet to look at the star child website. I was working on units that are part of the district curriculum and following the new textbook series. I need to do a better job of consulting with the grade level teachers to insure my lessons are a positive influence on what they do.

Reflection Comments “Christina” (continued):

W3:
I tried to review previously taught materials with my 3 special needs students to prepare tem for the unit test. We reviewed acuities previously completed and used an e-field trip to review general knowledge of earthquakes and volcanoes.

W4:
No Comments

W5:
MontCas testing this week.

W6:
We finished using Knowledge Box and will now use the website www.brainpop.com. Great little movies on earth science. I did have to purchase a subscription. I cheated and got one for my home for $9.99 a month. I am not sure how that will work with the whole group. We can always watch them on my board.

W7:
We finished using Knowledge Box and will now use the website www.brainpop.com. We are still using brainpop. I first go through the movies and try to explain more of what the movie is about. Thanks to Frankie I sound knowledgeable. We have a group instruction than same groups make sure everyone has three answers. In most classes it is working well. My special needs students worked with one science fair project on soils. We are next week doing the second experiment with soil types and growing seeds.

W8:
We use the website www.brainpop.com. We are still using brainpop with 3rd and 5th grade. I first go through the movies and try to explain more of what the movie is about. We have a group instruction than same groups make sure everyone has three facts. In most classes it is working well. My special needs students worked with one science fair project on soils. We started types of soil types and growing seeds, by Fri we had radishes in topsoil, sand and potting soil. It is pretty exciting. The experiments are from the AIMES materials. I have had some problems with school counselor. She decided that she knew more about what was best for a student than me. She thought he should choose. I said I would take care of it so I would continue to teach science and the scientific process at the same time. I believe in choice, I also believe in teaching skills in a genuine situation. We as a staff need to work together for the benefit of students. I guess my point is there is lots on interference when it comes to some students. I work with another special needs student no one seems to care about. That will be the last time I refer a student to the counselor. It did not help the student only confused the guy and his education program. There is only 29 days. Yeah!!

Reflection Comments: “Angela”:

W1:
This week we worked on constellations using "Sky Tellers" that I received at the leadership conference. I chose to do this because we are doing a unit in our reading curriculum on Survival and constellations tied in with a few of the stories. We watched the video on constellations and

discussed what a constellation is and how different cultures view them. Then we created our own constellations and wrote a story about them.

We also are working on Vertebrate books in which we identify the different vertebrate groups and their unique characteristics. It's in the science curriculum and I believe questions related to this are on the standardized tests. It is also a part of our language arts as we are working on how to do note-taking and finding main ideas and supporting details.

W2:
This week we worked on typing and editing our stories on the student-made constellations and how they got to be in the sky. They did this individually throughout the day. We are going to create posters with our stories and constellations to hang in the hallway.

We also are working on Vertebrate books in which we identify the different vertebrate groups and their unique characteristics. It's in the science curriculum and I believe questions related to this are on the standardized tests. It is also a part of our language arts as we are working on how to do note-taking and finding main ideas and supporting details. We discussed fish and mammals this week.

W3:
This week we continued to edit our stories on the student-made constellations and how they got to be in the sky. They did this individually throughout the day. We are going to create posters with our stories and constellations to hang in the hallway.

We completed our Vertebrate books in which we identify the different vertebrate groups and their unique characteristics. It's in the science curriculum and I believe questions related to this are on the standardized tests. It is also a part of our language arts as we are working on how to do note-taking and finding main ideas and supporting details.

We also created concept maps on what the students know about rocks. This is going to be our next unit because it is of interest to the students, it's in the science curriculum, and I am working with this in BSSP classes. They were to do their concept maps individually although we created some categories together of what they might put on their maps. I will look at these to determine what exactly I will cover and how I can connect the material to what they already know.

Reflection Comments: “Angela” (continued):

W4:
The only science we did this week was in taking the CRT on Science as mandated. Over half of my students were read to for this portion of the test.

W5:
This week we started a new unit on rocks. We made simple observations of rocks and began looking at how scientists classify rocks and how they choose the properties in which they best classify the rocks into groups. This is in our science curriculum, of great

interest to the students, connect to the culture, and will work well with what we are doing in BSSP.

W6:
This week we reviewed why rocks and minerals are important and what they are used for around us. Then we did an assessment on how they are able to see the rocks and minerals around them in the classroom. Do to having a substitute; we did not have much time for science this week.

W7:
This week we created mineral structures and made comparisons. We also looked at how igneous rocks are formed and did a lab where students grow salt crystals to simulate magma cooling off and hardening to form rocks. We identified some basic minerals.

W8:
This week we did another experiment showing how rocks and minerals melt to form magma and harden to form rocks. The experiment showed how minerals have different melt/hardening times and that will change the composition of the rock. We also discussed how Bear Butte and Devil's Tower were formed and how that relates to igneous rocks, as well as reviewing basalt and obsidian being used by the Cheyenne.

W9:
I was sent to a writing curriculum training on Monday and Tuesday of this week – the students did not complete anything while I was gone, so the remainder of the week had to be used for condensing a 5 day week into a now 3-day week while getting behaviors back on track. No science this week. :0(

Reflections Comments “Michelle”:

W1:
I wanted to have my students have a basic understanding of tectonic plates and their affect on the planet’s mountain ranges, earthquakes and volcanoes. My textbook does not really have materials on tectonic plates, so I used the information I learned during my classes and the materials that we provided. I have found that it is best to assume that my

Reflections Comments “Michelle” (continued):

students know nothing and start at the very basics. At times it is refreshing to find that they do know a lot more about what we are doing.

W2:
I believe that this week the greatest influence was that it was a short week because of our winter break and I wanted to get some science in some way. The quickest way was to get them prepared for the next chapter in our text on matter. So I just had them look up the vocabulary words and write their definitions in the science journals.

W3:
As I am writing I can see how parents do influence my teaching science. Our school started a recycling club and I was surprised on how my parents signed permissions slips to have their child join. This was a teachable moment for me because we had just covered taking care of our natural resources as such the metal resource. Our investigation involved paper clips representing a metal resource and as each generation pick five clips we soon ran out. We discussed what we could do so that there would bd metal resources left for future generations. As parents come for conferences they do expect to hear what their child has learned in the area of science. I have a disadvantage of not really being raised traditionally and I tend to forget to incorporate the elders of the community to come share their wisdom and knowledge about science.

W4:
We are not a public school although we do not have our students take CRT’s. The test results help me to plan for teaching my future science classes. It seems like the first subject to go is science whenever our schedules get interrupted. This year I have tried very hard to keep at least one or two lessons in science going. Science is my weak area and would rather let it slip by, but I felt accountable to someone as I progress in my classes. If not to myself it is to the professors who are helping me with their knowledge of science. This enables me to understand and have my students get an idea that science is fun and learnable.

W5:
I guess with finishing with our testing recently, I want to get as much teaching of science as possible so that my students can compete in the test on an equal standing. My students are very interested in science and this really helps me want to teach them.

W6:
This week’s lesson was on the conformity of measuring with the same object. My students quickly caught on that it is easier to measure with the same unit of measurement. The measure their height and their arm span with markers and erasers each separately. They found that could not come with the same measurement so they decided to use either

Reflections Comments “Michelle” (continued):

the marker of the eraser so it was uniformed. It is always so refreshing tto see their minds at work when we do these investigations.

W7:
Since I teach at a Catholic school we are not in districts as are public schools and there are no district test. We are required to take the CRT’s and Iowa Basic Test of Skills so as to have a standard to keep up with. I need to know the state standards more so as to incorporate them into my lessons. I know that I am teaching standards, but I want to understand and know that I am teaching this standard with a particular lesson I am teaching. May be in our classes we can get in more state standards.

W8:
This week was an exciting week with Elisabeth coming to observe my SCOOP lesson. My students were really anxious to meet my instructor. We did an investigation on how the air temperature affects the different types of surfaces. We took the temperature off the grassy area right in front of the school building, then on the sidewalk, and finally on the gravel on the playground. The warmest temperature was on the grassy surface. We did have quite a bit of wind that day, so I was thinking maybe it hindered our investigation. I plan on doing it again on a non-windy to see if our results are the same or not. They really enjoyed Elisabeth coming to our class.

Reflection Comments “Sarah”:

W1:
Our district has set-up an outline for the school year on when to teach three areas of Science and we are now in the Earth Science section of the year. It also fits very well with our Reading right now because we are in the unit of Fossils so I am able to do a lot of cross curriculum teaching.

W2:
I really tried hard to bring in what students already knew about rocks in this area by what they observe. Then, I moved them into how those are used in everyday things that they didn’t know about.

W3:
My biggest thing this week was trying to figure out how to “wrap-up” my Earth Science by the end of March. The class is doing a great job with their rocks and soil and is beginning to form their own questions to ask.

W4:
I worked really hard on trying to bring in more culture to our study of rocks this week, but I was unable to find someone to come into my room.

Reflection Comments “Sarah” (continued):

W5:
My biggest thing this week was trying to figure out a schedule to finish up the unit in my allotted time for teaching Earth Science following the district's essential map.

W6:
The class has finished with their observations and then next week they will be able to present, form and answer questions, compare and contrast, and we will then be ready to dig deeper into the subject area.

W7:
The class worked on reading a science textbook and working together on some worksheets.

W8:
The class worked on a website that was about testing rocks' characteristics. Since they have already held the actual rock in their hands, it went very smoothly.

Reflection Comments “Tiffany”:

W1:
Our classroom needed to spend more time on frogs and toads. Our cultural teacher, Douglas Spotted Eagle, checked with some community resources for us to determine which frogs reside in our Lame Deer area. The three most common types are the boreal, woodhouse and northern lepard frog. We looked at pictures of these friendly frogs on the internet. I read the book From Tadpole to Frog by Wendy Pfeffer. It has beautiful pictures and presents the subject well. The students worked in small groups and did a cut & paste activity showing the tadpole to frog cycle. I thoughly enjoyed the lesson. It felt easy & enjoyable for everyone.

W2:
We read two of Arnold Lobel's stories about Frog and Toad in our 90 minute reading block. The class enjoyed comparing and contrasting the similiarities and differences between frogs and toads. We went on the internet to several sites to see pictures of frogs and toads. Our classroom culture teacher checked for me to find out what frogs and toads reside in our area. We discussed Crazy Head Springs and why all the frogs are gone this time of year. All of our students like frogs and toads and I felt it was a relevant and appealing study.

W3:
I wanted to do the orange peel activity with my students to get a feel for classroom response. We peeled the orange and discussed plate tectonics. Also we discussed earth

Reflection Comments “Tiffany” (continued):

quakes and mouontaini formation. The students seemed fascinated and amazed. They didn't have comments or questions. They seemed to be very impressed.

W4:
We did two studies using technology. The first study was at http://www.classzone.com/books/earth_science/terc/content/visualizations. There were six minerals: halite, quartz, qypsum, fluorite, graphite, gold. The students viewed each of these minerals in color on the web page. When they moved the cursor over each image, they could view a common item made from each mineral. For example, halite & table salt, quartz and glass, gypsum and building sheetrock, florite and tooth paste, graphite and pencil lead, gold and jewelry.

The second study was an interactive workshop from BBC - Schools Science Clips - Rocks and soils (bbc.co.uk). Each of the following rocks were placed in a tester: slate, marble, chalk, granite & pumice. Each rock was tested to meet the following criteria: 1) Is it permeable? 2) Does it split? 3) Does it wear well?
4) Does it float? The workshop provided a quiz to determine if the students could relate the concepts covered to life observations. I was quite impressed with how much some of the students grasped the concepts.

W5:
The two main contributors to the lesson this week were technology and the students prior knowledge. We went to the web site www.hitchams.suffolk.sch.uk. Click on the school web sites, science and habitats. There were six habitats represented: ponds, farms, homes, sea, hedge, wood. Each habitat had pictures of animals which lived in each of the places. We then sat in a circle on the floor and each child had several turns telling about creatures which live around us at Lame Deer.

W6:
The students and I are studing different types of rocks. We are each making a rock collection and a notebook. This week we studied lava, sandstone, limestone, granite and crystal. We also did a dinosaur dig for fun.

W7:
We worked on a dinosaur dig Monday through Thursday (and also discussed dinosaurs). On Friday our culture teachers discussed how dinosaurs lived on our land, reviewed how volcanoes related to local rocks, and also showed us beautiful local clays.

W8:
We are beginning Unit 10 in Open Court Reading (which is a study about homes). I have begun a study about habitat in science to parallel this study. This week we studied animal habitats and also our local habitat.

Reflection Comments “Heather”:

W1:
No Comments

W2:
No Comments

W3:
This week I started a unit on weather and was more able to apply hands on activities. It requires more plan time.

W4:
We continued to work on the Weather unit. We graphed our data the children collected on the temperature. We need to analyze it more. They constructed water cycles and raindrop stories.

W5:
I am following a textbook curriculum framework but pulled out the FOSS kit to supplement the students learning. We were discriminating between sounds. The students learned that sound is a property and has properties. They also used a drop code for their sounds and spelled words. We talked about Morse code. and how during the war they used the crow language for a secret code.

W6:
This week we referred to our textbook to review what we learned using the FOSS kit on sound. Then we related it to light. We made bar graphs and did the chapter review.

W7:
On Monday the class finished the unit on weather by taking a weather assessment. BSSP influenced my teaching because I was finishing my SCOOP, Tuesday and Wednesday they went on a field trip to Mt. Rushmore. Thursday we started seeds. We did an inquiry about seed identification. I had seeds that the students were to guess what they are. Then we watered it. Now we will collect data on the growth of the seeds.

W8:
My fourth graders are working on making graphs in Math. This week I collaborated with science. With data we colleted I asked for them to find the mean, mode, median, and range. They were excited to apply their skills.

W9:
This week we referred to our text book to review what we learned using the FOSS kit on sound. Then we related it to light. We made bar graphs and did the chapter review.

Reflection Comments “Melissa”:

W1:
The BSSP class has had a great influence on what I am teaching in science this year. I have used a lot of material from books that I was given by them. They have been a great help. Today I taught a lesson form one of the books. The lesson was on sedimentary rock formation. The students enjoyed it and I hope they learn something form it.

W2:
The thing that has had the most infuluece on what I teach is BSSP. I have tried to stay with what they are teaching me. This week I read the students a story that was written by two of us during last summer institute. It was the life circle of a mineral. The students were to illustrate the story. At a later time I will have them write their own story of the life of a rock or mineral.

W3:
We were testing so I didn’t teach science this week.

W4:
What has the most influence on what and how I teach is BSSP.

W5:
BSSP(Big Sky Science Partnership) has been a great influence on what I have been teaching.

W6:
What my students already know always has some influence on what and how I teach. However, if I only taught things they have some knowledge about I wouldn’t be teaching much science.

W7:
We looked at the modles of sedimentary rocks we made two weeks ago and observed any changes. Discussed what made the changes and how it relates to sedimentary rocks.

W8:
BSSP was a great influence on what was taught this week.

W9:
Again my total reason for doing this had to do with BSSP. The students enjoyed it ans I will do again next year.

Reflections Comments “Rebecca”:

W1:
Other: Science this week was an introduction to a new unit "Soil". Because of a lack of resources I used what I learned in the BSSP courses to develop this unit. Using the "design backward", I started with the end result. What did I want the students to learn? I used 4 topics and also subtopics, (the students interest). We began with a KWL chart. First session was: What do you know about soil? Students brainstormed, and we put on a chart. The next day we did the W: What would you like to learn about soil? Again student responses were recorded. I included what I wanted to learn about soil, and my question was: How did the Northern Cheyenne and Crow tribes use soil? Students then looked at three soil samples in small groups. Thanks to last summer I had collected samples from various places on NC and Crow reservations. The students then listed the properties (color, texture, size-rocks in 2 samples) of the sample, where the sample came from. They made a table of their observations. The KWL chart, tables, and vocabulary words are used as part of the bulletin board. A link was made to the "Rock" unit, which was done in the fall, and reviewing some of the concepts really from the unit helped students to make the connections of where soil comes from. I had the concept map that we used from the rock unit which was helpful. I learned that students know a lot about soil, and their questioning is at high level. The discussions were helpful to me as the community has a great influence on how students view soil/dirt. One student's comment to what we know about soil-"we use it for graves". I am excited about the unit and especially in the development of the learning experiences/activities for the students. Science is fun!

W2:
Science this week focused on reading vocabulary and developing a concept map of our theme “soil”. Student interest about the type of soil that flowers need was explored. We will plant flowers as part of the unit. One session focused on vocabulary words and all students made a list, then transferred the list to 3 x 5 index cards. During discussions the cards were used to help answer questions and understand the words. Wery useful for all students, I have a non reader and one who is below 3rd grade Reading level. When we read as a group all students have an opportunity to participate. (initative reading for the non reader, below grade level reader). Because students do nt have a text, I copy the reading material. I found that students enjoy science. I left all materials out in science area from previous units, and when they have free time (earned) they find something to do in the science area. Also there are visual materials for there use.

W3:
My science teaching this week was influenced by wgat my students know. This week wneds the soil unit, so we finished with soil layers, read about science in the news and did review and prep for test on soil unit.

Students kept data on their plants and vegetables which were planted 3 weeks ago. Discussion about why some plants grew fast, others did not grow. They measured

Reflections Comments “Rebecca” (continued):

growth, and illustrated their observations. I told students about research that showed how plants grow more when they are talked to. The students were talking to their plants before leaving for the weekend (no school Fri. & Mon.) and they would not observe them again until Tuesday (four days later).

Accomodations made for 2 students on IEP. Helped them with writing their data – they did their own measuring of plant growth! One wrote: “no growth – 0 cm”. I have also included a copy of a song we will use for the rock cycle:
Rock Cycle Song (sing to the tun of “Row, Row, Row Your Boat”)
SEDIMENTARY rock, has been formed in layers, Often found near water sources, With fossils from decayers…Then there’s IGNEOUS rock, Here since Earth was born, Molten Lava, cooled and hardened, That’s how it formed…These two types of rocks, Can also be transformed, With pressure, heat, and chemicals, METAMORPHIC they’ll become.

W4:
Student evaluation of the unit on soil this week showed that the students did not do as well as I thought they would. They completed the first part – these were questions that the students developed . I asked the questions to get answers o their understanding of the unit. One student (on an IEP) did not complete the questions. Based on student responses I will do about 3 demonstrations/review so they see and we can discuss. (i.e. When you pour water into the soil, why do bubbles come up?). Another point will be when you put a seed in water, do you have to put soil in with it? Students germinated apple seeds without water, so we just need to revisit. (Also, there are plants with roots in a jar, only with water (no soil) and the plants continue to grow). A question that most of the students missed surprised me. How old is soil? This question will aso be revisited.

W5:
End of unit test. I must look at alternative assessments. The multiple choice and fill in the blanks (words provided) is not working. Its so frustrating . Now I know how the students feel when they have to take a test!! The results of the test showed only 1 out of 5 passing. Two students did not complete the test. This was the week to do other district tests, do I’m thinking the students were “tested” too much. I would like to try more visuals, the vocabulary words probably need to be used/studied more. I will explore authentic assessment especially for these students (Native American/American Indian). On a more positive note – students completed the L* of the KWL chard for soil unit. I was pleased with their comments (soil is my SCOOP project). * What I Learned about soil?

W6:
BSSP observation this week. I revisited soil unit – students were to draw what they learned about soil. They we did an activity called dirt and worms. It was fun, revisiting

Reflections Comments "Rebecca" (continued):

the layers of soil. We used jello pudding, crushed shocolate and vanilla cookies and toped with worms, bugs (candy, of course) and coconut dyed green. The students answered question as I demonstrated how to make individual servings. (the questions I tried to link with changes i.e. rocks). This was the last activity for soil unit. Students cotinue to care for vegitables and flowers they planted (3/08). I tolf them they all have "green thumbs." Also, this /past week introduced the fossil unit and using the KWL Chart and concept web. We went on a nature walk – told the students we wer going whether it rained or snowed – it rained but we still went – They had a great time. It was a lesson intgrated w/ social studies and language arts.

W7:
Our science theme/unit this week is fossils. We have completed the Know and the Wondered/(What I want to know) on the KWL chart/Fossils. The following is what 3rd Grade Know about fossils:
They can be bones; They are made from dinosaurs, leaves, or shells; They are made out of dinosaur "poop"; Fossils can be decorations; Fossils cost lots of money.

The next activity was what they Wondered /Want to know about Fossils. They came up with the following:
Are Fossils alive?; Whay are dinosaurs ectinct?; *What are fossils made of?; *Where do fossils come from?; Do fossils break?; Why do we have fossils?; How do we make a modle of a fossil?

What students know and what they wondered about will help to design lessons for the fossils unit. I found that some of the questions thye asked were the same questions I came up with when developing the unit. * The challenge is to integrate cultural knowledge into the unit. Students are highly motivated and they think science is fun.

APPENDIX H

INTERVIEW TRANSCRIPTS

Interview Transcripts

Interview 06090801
MSSP Subject: Christina
Interviewer: R. Jones

RJ: If at any time you feel uncomfortable with a question or interview, just let me know and we will move on or conclude it OK?
Christina: All right.
RJ: I just a few questions to ask about your school and your teaching, ah, do you have any questions for me before we begin?
Christina: No sir.
RJ: OK, um, just for the record would you state your name and where you teach?
Christina: My name is XX and I am the XXXX at XXXX School.
RJ: Great. All right, well thank you very much for participating both in this interview and all the stuff you have done with the BSSP. Sometimes schools and districts make it easier for teachers to teach science and sometimes they make it a lot harder, they kind of get in the way. Think about your teaching, um the situation that you teach in and what influences how you teach science.
Christina: I'm very lucky, I have a pretty open curriculum as long as I am teaching something in technology, I can do basically anything I really want to.
RJ: So in your school you get to decide what you're doing because, if it deals with technology.
Christina: Yes, I do.
RJ: OK, so the district doesn't decide for you what to teach?
Christina: I have, there is a curriculum standards and bench marks that were established, oh probably about ten years ago that I try and follow.
RJ: OK, good. Sometimes other people in the school and district can influence your teaching. Does your principal have any influence on your choices of lesson or how you teach?
Christina: Yes, he would. If he told me I wasn't suppose to teach something like keyboarding he doesn't like, I don't hit it as much.
RJ: What about other teachers in your school?
Christina: I try to follow the grade level curriculums that are provided and if there's a particular thing that somebody wanted to have me introduce or teach I would work that in.
RJ: OK. What about parents or the community, how do they influence what you teach?
Christina: I guess I don't feel much influence from the parents but I do try to incorporate cultural information.
RJ: OK, Um, school board?
Christina: No, school board.
RJ: District administration. You said the principal, What about superintendent that kind of…
Christina: Not the superintendent that much, but we do have ah technology…group, and I do listen to what they say.

RJ: OK, anybody else?
Christina: Not really.
RJ; National policy, state policy, anything like that?
Christina: Nope.
RJ: Nope, OK, good. Sometimes the physical setting and access to resources can influence your teaching and choice of lessons. Do you have resources needed to teach science and or technology?
Christina: I have plenty of resources for technology. We have at least one computer per child in the lab, two computers in each classroom plus three mobile labs.
RJ: In your lab how many does that come out to be?
Christina: I have…um…twenty-three that ran system ten, Mac system 10.
RJ: So, that would be a class size of twenty-two?
Christina: Well, twenty-three students was the most.
RJ: OK. Do you have adequate space for what you are doing then?
Christina: I wish I had more, but yeah, it works.
RJ: As long as they not big people everything is fine?
Christina: Uh hum.
RJ: What grade particularly?
Christina: Third through fifth.
RJ: Third through fifth grade, OK. Um, sometimes access to ideas and professional development can influence your teaching and your choice of lessons. How has access to ideas and professional development effected your teaching and or choice of lessons?
Christina: Well the BSSP program has really, um… expanded my horizions in science. We don't have a lot of staff development for technology so I pretty well.
RJ: So its not like a district mandate about technology education or PD in technology?
Christina: I think they'd like to do that but they're more into reading and math.
RJ; What are the benefits from participation in professional development have you observed in your teaching?
Christina: I like to incorporate the ideas. I did go to a differentiated learning conference last year and I have been trying to incorporate some of those ideas into it.
RJ: What, who is the main provided for PD that you are able to receive?
Christina: I not quite sure. It was the middle school principal at one time. I think each building tries to decide what they want to do…but…I don't know who's really in charge.
RJ: Is there anything that you think I might have over looked asking questions about professional development, or anything like that?
Christina: No, I don't think so.
RJ: OK. What do you feel drives the amount of time that you teach a specific content?
Christina: The…I have pretty open lessons. I've got a lot of luxury in that, and I judge the amount of time I take on a lesson based on student output and performance.
RJ: Based on student output and performance, good. So is that how you decide what to teach and not to teach?
Christina: Yep, cuz I was gonna do some cultural…ar listen to some Native stories. But, the kids couldn't handle listening to stories so we moved on to something else.

RJ: When you say they couldn't handle what do you mean?
Christina: They were very active, ah thir… third graders touch feely.
RJ: So nine to ten year olds, their attention span's about nine…
Christina: Their attention span was really bad.
RJ: OK, "laughs".
Christina: Still is.
RJ: Yeah, Um, have you adapted or how have you adapted your teaching to meet local, state, or national mandates?
Christina: I try to…I feel pretty confident about um, being able to find state standards, local standards, and when I am teaching a lesson. And I think that is something the science project has helped. Is going back and seeing what the standards and benchmarks are and trying to make sure that fits into the local curriculum. That I'm not teaching dinosaurs in the third grade and they really have dinosaurs in the second grade cuz it's a waste of time. Unless it meets a technology benchmark, and then I feel I am pretty open to do what they want.
RJ: So your really basically caught between two sets of standards then, science standards and technology standards?
Christina: Yes, I am.
RJ: Or math standards. So you're kind of marching to a bunch of different drummers?
Christina: Uh hum.
RJ: You are in a unique situation…
Christina: I am.
RJ: …in that case.
RJ: How do you maximize student learning in your classroom or in the lab?
Christina: I try to give um as much hands-on as I can. Teaching them a lesson, and then having then do some guided practice. I really like students helping students. More so than me helping them.
RJ: So then how would your describe your role as a teacher?
Christina: A strict disciplinarian.
RJ: You just said that you like to work…
Christina: Well I do, I do. Um, my role? I like, I do like a structured environment but…I don't know it depends on the class and it depends on…um…the lesson. What I see my role as.
RJ: How do you know when your students understand?\
Christina: Interesting question. I know that my students understand if they can teach each other.
RJ: Ok, excellent. That's excellent. How do you decide when to move on to a new topic?
Christina: When we've basically finished our project.
RJ: So you do project, mostly project oriented?
Christina: Mostly project based.
RJ: OK. How do your students learn science or technology best do you think?

MSSP Subject: Christina (continued)

Christina: Hands-on. I also worked with a special, a group of special needs, three special needs kids and their science was…they learned best by doing, touching, feeling. And I think that's true with the other kids. It's really hard at third through fifth grade for kids to read and come up with the information. I like to incorporate, um, I think my masters will be on technology literacy but I'd like to incorporate more hands-on if I had the space. I really don't want to do volcanoes with vinegar and soda in a computer lab.
RJ: XX I really appreciate your taking the time to answer my questions. Do you have any questions for me?
Christina: No.
RJ: No, Thank you.

Interview 06090802
MSSP Subject: Rebecca
Interviewer: R. Jones

RJ: OK. So before we get started I need to have your name and when you teach for…basically my records. Your name won't be ever used in any of this stuff so.
Rebecca: My name's XXX and I am a XXX grade teacher at the XXX school in XXX.
RJ: And if XXX at any time during the interview you feel uncomfortable with a question or you don't want to answer, just let me know and we can go on or we can stop. OK?
Rebecca: Sure.
RJ: I just have a few questions for you. Um, that I would like to ask about you, your school and your teaching. Um, but forst do you have any questions for me before we get started?
Rebecca: No, I don't think so.
RJ: OK. Good. Um, sometimes schools and districts can make it easier for teachers to teach science and sometimes they get in the way. Um, thinking about your teaching situation what influences how you teach science?
Rebecca: Well, I think what influences, what influences me how I teach science is where…what students know…you know, their prior knowledge and experience and what they bring to the classroom. And also…um who they are, you know, um, in my classroom room all the students are either Northern Cheyenne Tribal Members or Crow Tribal Members.
RJ: So you have 100 percent Native American population.
Rebecca: Yes, I do.
RJ: Ok.
Rebecca: And I think the other thing that influences the resources that are available…but you know the school, the school also influences because they say, well this is a science curriculum you know, these are the guidelines that you have to follow so.
RJ: Oh, OK. That actually answers a couple of the questions that I have. In your school do you decide what to teach or what not to teach or is it decided for you by administration or department chair or curriculum.

Rebecca: Well my experience has been, um, that I have to follow the guidelines, but I pretty much have decided what to teach the kids based on, um you know like I said the resources that are available to me and of course my knowledge uh, that I have about science. And, you know if I, I've said it several times that if I wa was not in this program, I did not have these resources I don't know what I would do for the science cuz I don't have any resources in the classroom. But that's gonna change…
RJ: Oh good.
Rebecca: Beginning you know next year were putting in, you know, a textbook for the students to help.
RJ: Oh that will be good because you don't have a specific textbook now. In your…um…sometimes other people in the school and the district can influence your teaching. Does your principal have influence on your choice of lessons or how you teach?
Rebecca: No, not…well, I guess…he does, the principal does in a way you know. Um, and for instance there was one day that he wanted set a side that he wanted all the teachers to.. use it as a topic so, he does have that influence and then also ah you know because we, because our school is in ah, what they call it, improvement, or.
RJ: A plan of improvement?
Rebecca: Yeah, so then we have to follow those guidelines, and so then he's, you know he… when we have to do our lesson plans we have to do it a certain way that he has given us a structure to follow so we need to use that, implement it, so that our students will improve…laughs. You know and um, its working for me.
RJ: That's good. How about other teachers in your school, do they influence what you teach at all?
Rebecca: A little, in some ways. For instance, like I will, like communicate with the fourth grade teacher and you know what she's covering in her science class I will not cover in my XXX grade class because then I say they will get it when they get over into the fourth grade. So we might, you know, just scrape the top of the surface of the topic and then…if they are really interested in stuff you can have it next year when you get into the other classroom. So, um, that kind of influence you know?
RJ: So its more or less a collaboraltion in a sense.
Rebecca: Yes.
RJ: What about parents and the community?
Rebecca: I haven't um, had much um, communication with the parents about you know, what to teach in the classroom. So, Like I said, mainly follow what the school has set down as their curriculum and hopefully at some time, you know, the parents have been informed this is what your…what's being covered in this classroom or in this grade. And wheather that's happened or not I don't know.
RJ: That goes along with school board or district administration, they do have some influence I imagine?
Rebecca; Yes they do. Uh hum, they ah, they approve the programs that we have to do because like I said, the status of our school. So you know we have to teach the certain reading program, certain math program, that's what we have to use.

RJ: Is that do the national rules or is that do to state mandates?
Rebecca: I think its…its probably the national because you know um, we do the standardized tests and of course you know because the BIA does provide, I guess the funding we have to follow their guidelines. But then again it's the state too because ah, you know, we have to follow the state standards…their benchmarks. Because I don't think the BIA has…the BIE has their own so we follow state.
RJ: Anybody else that you think has influence on how you teach in your classroom?
Rebecca; Students.
RJ: The students. OK.
Rebecca: Big part of it. Um, and when I teach I like to, you know, like I said get their prior knowledge about the topic and also their interest…what interests them about that topic. RJ: Uh hum.
Rebecca: And then I can go from there and what I, you know, as I go along I find out what works and what doesn't work. And, and you know that influences…my teaching.
RJ: Um, thank you. You mention this somewhat already…but sometimes the physical setting and access to resources can influence your teaching and choice of lessons. Do you have the resources and material needed to teach science?
Rebecca: I think I do. And if don't then I um, I get on the internet…clears throat (excuse me). I get on the internet and you know pretty much I can gather enough information so that I can, you know, teach the lesson or the theme, whatever I am doing…for the students. Whether it's a three week unit or a whether its just, you know, a week depending on a topic.
RJ: Do you have adequate space in your classroom?
Rebecca: Yes, I have adequate space.
RJ: OK. Um, what benefits from…excuse me…what benefits from participation in professional development have your in your own teaching?
Rebecca: I think, ah, the reflection part. Has really helped me to think about, you know, what I'm teaching, if the students got it and if they didn't get it then what do I need to do, you know, to re teach that or maybe do it different in a different way. Um, I think that, you know, that has ah, really helped. And with the resources, um, you know, I just try my best to get the resources wherever I can.
RJ: Um…so the benefits for participating in, for example, you mentioned the BSSP has been basically access to ideas and content.
Rebecca: Uh hum. And, in materials, equipment, supplies.
RJ: Is there anything I might have overlooked in asking you questions about professional development and how it influences, and the community and those things?
Rebecca: Well, it, ah, it has really helped me, you know, because I have been out of the classroom for ten years. I was in administration as I got back into the classroom and started teaching…you know how it just sort of comes back to you and as I reflected on that, you know, um and all the training I have received…then it kind of made me re think about how when I was a teacher and I wanted to change things, I would say, well I gonna become a principal so that I can change things. But now that I am back in the classroom I know that change, the teacher is in charge of the change (laughs).

RJ: That's actually very enlightening for me to hear that.
Rebecca: But I mean that's my experience.
RJ: Great. Um, I just have a couple more questions for you. What do you feel drives the amount of time that you teach a specific content, be it English, mathematics, or science, or social studies?
Rebecca: Well, I guess, for science, um, I pick science because, you know, the other stuff is cut and dry. And science is just kinda like in where I'm at, its kinda left up to you and you, whenever you can find this time. But what I've done is because of the student interest and because of my interest and I have tried to do it ever day, you know, for thirty minutes. Because I have the younger kids and that works well and I've, you know, when a kids, when we first, when I first start working with them they would say, what is science and you know, just, it was just like, I don't like science. But as we got into science an you know was doing it every day and doing different things, different topics that...it was fun and they liked it. And it was, they would, they would make comments like, oh I really like science. Or they would say, what are we doing today. And you know things like that. So, um that's, and I would like to spend more time, but you know because we have so many other, these other things to teach that I try, you know, to do the best I can with the science.
RJ: OK. How do you maximize student learning in your classroom?
Rebecca: That's a hard question. (laughs) Um, But from experience…I think it really helps to have a, you know, to have ah structure set up, you know, so that the students are aware of what…you know, what they need to do to learn this stuff. And kinda like, ah, consistency and you know, like how you present something… so that, you know, they might be getting the same, I guess you would call it organizational…oh, you know, how you organize..um, so like if you do do'er, doing it here in August and September you're doing it throughout the whole year so that, you know, it's consistently reinforced and there is, you know, ah they're used to it and they will say, oh I know how to do this or, you know, getting that, and just really having a structure there and having high expectations for them and, um you know just really being consistent and, and making sure that your lessons are ah, structured so that they can master the content.
RJ: That'll help with… and I think lead in to a couple of the questions. We're just about done. How do you describe your role as a teacher?
Rebecca: My role as a teacher is to… make sure that my students learn, to make that they progress, to make sure that they achieve and, you know, no matter where they come, where they come in, but to begin with, you know, to begin with them and to bring them, bring them, you know, to their potential. And um, I…I was really concentrating, this year really concentrating on reading and what I found out was that when they're successful in one area it is gonna show up in other areas. And I was surprised because the reading scores went up, the math scores went up, their language scores went up. And I though, wow, I didn't expect this, you know?
RJ: So that, that leads into the question, how do you know when your students understand what you're covering?

MSSP Subject: Rebecca (continued)

Rebecca: They'll tell you. (laughs) They'll say, oh I got it, or you know, they'll make comments like that. Um…and..or, they'll, you know, talk to themselves, how do I do this…and then when they figure it out then they gets this light bulb or something and they'll say, oh, OK, I got it, well that's, I know how to do this and you know they'll go on and they'll, they'll finish what ever it is they have to do and just um, it just shows in their work. You know, ah, so if do it in one area then you're consistent in all the other areas, then you know that your kids are learning, you know that they're progressing and just keep, you know, praising them and um, and I always have them make goals no matter what it is, you know. When they reach the goal, then you know, affirm them and give them good kudos, I guess you would call it (laughs).
RJ: How do you decide to move on to a new topic in your classroom?
Rebecca: Well, that, that was kinda of ah…eye opening experience for me this year because like, I would, so I have this unit, you know, I have it all planned out. OK, so I'm gonna do, do this topic maybe three weeks. And it doesn't turn out that way. You know, as you, like during the week of testing we couldn't get into…we couldn't get it into our science because we had to have ninety minutes of reading, ninety minutes of math and we had to have that everyday. Even if we test in the morning we had to do that so, so then it would, you know, turn out to be maybe four weeks, maybe five weeks. But I thought, well, that's just the way it goes. And so you just have to be really flexible and now that I think of it, you know, just for next year, planning next year gonna be different.
RJ: OK, last question for you. How do you, how do your students learn science best?
Rebecca: I, my students learn science best, best by doing science. And, a lot of modeling, you know, if the teacher demonstrates first. And shows them, then that's what, that's what helps them. Or even, you know, just talking, well, just talking about it. Or you know, their prior experience, if one already knows how to do it then use them, and you know have the other groups use him as a helper or whatever. So, those are the things that have worked for me.
RJ: Great. Thank you. Do you have any questions for me? We've concluded the questions I need to ask so do you have any questions for me?
Rebecca: No

Interview 06090803
MSSP Subject: Jessica
Interviewer: R. Jones

RJ: If at any time you feel uncomfortable with a question or the interview in general, just let me know and we can move on or we can conclude the interview. Is that OK?
Jessica: Uh hum.
RJ: I just have a couple of questions I would like to ask you about you school and your teaching. But first do you have any questions for me?
Jessica: Nope, not yet.
RJ: Do you like this I have to have a script?
Jessica: That's all right. It's like I was just trying to look at the questions.

RJ: It's silly, but it is the only way that I can remember what I am doing.
Jessica: No that's all right. You don't have that many questions.
RJ: Sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation what influences how you teach science?
Jessica: Because of my title, being ah, duh, Ok, I'm blank right now. Um, reading/math specialist and then strictly required to do all the intervention programs for reading an math at the grade level I am at. So science is like something that is just worked in, possibly in lesson and stuff. That is what I had to do with my scoop too.
RJ: OK. So in your school do you decide what to teach and what not to teach?
Jessica: No.
RJ: OK, sometime other people in schools and districts can influence your teaching. Does your principal have any influence on your choice of lessons or how you teach?
Jessica: Yeah, he does.
RJ: How about other teachers in your school?
Jessica: Uh hum, Yeah they have like, uh like, science curriculum, they have a science gal in our building who actually, they have it all mapped out on a piece of paper. Like um, the fourth grade teachers, this unit during this month, this unit during this month. And they have it listed by, you know like um, the different categories and they'll have like the book, like what chapters in the book are taught during that time frame. It might not be a month either. It might be just a two-week block um, let's say on, like the water cycle.
RJ: XXX where do you teach? At XXX?
Jessica: XXX XXX , yeah.
RJ: Specifically what grade level?
Jessica: Fourth grade this year, next year'll be fifth grade.
RJ: Oh, OK.
Jessica: I follow and move with my kids.
RJ: So will you go with them to sixth?
Jessica: No, they will go to the middle school at sixth.
RJ: How about parents and the community, do they have any, um, influence on what you teach?
Jessica: I know they have like a parent advisory committee…and they also have parents I know on the school board and things like that?
RJ: Well that was the next question, school board.
Jessica: Yeah.
RJ: How about your district administration?
Jessica: Yeah, oh yeah. They, and actually in our district, and I don't know if XXX talked to you about this too, is from my understanding each year a certain, like um subject, can buy books and I think um, was it last year or the year before, they bought science books. And so they updated those and then maybe this next year they'll be social studies and the year after that I don't know what.

RJ: How about um national policies or rules, do they have any influence on what you do?...Like No Child Left Behind?
Jessica: Yeah, oh yeah, definitely. Because I know a lot of our funding comes from nickelbee, or from them um what is it, the reading first grants.
RJ: Do you have anyone else or any other organization that might have a major influence on your teaching and how you teach?
Jessica: Not that I know of.
RJ: K, sometimes the physical setting and access to resources can influence your teaching and choice of lessons. Do you have the resources and materials needed to teach science?
Jessica: Emm, yeah I think over all. Yeah, I'm good. They've got, they do the FOSS um along with the book. Um, we also have a big cupboard where, I mean its larger class materials.
RJ: You said FOSS.
Jessica: FOSS and then the regular textbooks. They have a big storeroom, a work room, and in there, um its pretty open for teachers to just go in and borrow things and return'em.
RJ: So then when, how do…that answers the question about adequate equipment. But what about adequate space to do science?
Jessica: My room is probably about this size (jesters around interview room) not very big.
RJ: How many kids do you have?
Jessica: I have, um, my reading group is 14 and that's where I try to like do more science is during my reading block. Um, math is real hard its real structured it like you know we've got two different math programs going, one in the morning and one in the afternoon, and then…But reading, for myself, you know I have 14. As far as experiments, we really don't do them last year. It's more um discussion ah maybe reading a story about a tornados, is what we did our SCOOP. Kind of like that.
RJ: Great, sometimes access to ideas and professional development can influence your teaching and choice of lesson or lessons. How has asses, access phew, to ideas and professional development effected your teaching and your choice of lessons?
Jessica: More selective…I think, like there is some stuff you could do that um like I did, what I did is for my SCOOP I did stuff on tornadoes because we were doing Wizard of Oz. So I have had to fit that into too, does that make sense, you understand totally why I picked tornadoes. (laughs) But, it's kinda like I have to tweak some of the things that we do within our reading and add that extra ten-fifteen minute block of science. And so, um let's see I not done with it actually, Resources, a lot of the stuff it seems I get off the internet, um from our library especially the reading materials. I have a lot of reading materials too but, yeah, I think just finding materials…also I think um, during the classes that we've been doing um, helps you be a little bit more selective when you look at your group, you kinda have ta look and say OK, you get this upstairs, your getting this from me. You know, so kinda also that joint work with the teachers too.

RJ: Which you basically answered the second part of that question which is what are the benefits that you see from participation in the pd that you've been doing?
Jessica: Being able to share activities and um, not just activities, but information with other teachers I think too. XXX and I are like right beside each other and I can hear her do a ton because she's not so um, I pretty well told I have to do this, this, this; where she's got pretty much free rein. But it's really nice to hear that she's able to do a lot more of the science that deals with technology.
RJ: Is there anything else I might have overlooked that has an influence on your teaching?
Jessica: I know one of the biggest things is you have to be flexible. You really do. Flexible. Yeah, and I think that's one of the biggest things with teaching is you have to look at your kids this, you know, every year they are different, every actually every quarter they are different you know for me. But you just have to be really flexible and kind of see where they are and what they need. The science books are so far above where my kids are a lot of times. (laughs) You know that. But my content class we did like ah, I think it was a fifth grade social studies or science book and found that the words were like at tenth grade level you know and my kids some of them barely read at the first grade level and so you know a lot of its like coming down to their level and doing activities or finding activities that they can do and feel good about…so.
RJ: Good, all right we're on the home stretch here. What do you feel drives the amount of time you teach a specific content?
Jessica: Um, school, the principal and the reading coach on a lot of things because I'm really limited, like I, I have to get an x amount of the lesson done every day. And, um so my time for like science was like ten or fifteen minutes, like every other day. Which I mean my averages out to about, you know anywhere between thirty and forty minutes a week but, I didn't think that was too bad for what I am having to do. But yeah, I would say the school district itself is really strict on what the intervention teachers do.
RJ: How do you decide what to teach and what not to teach on your science classes?
Jessica: Wizard of OZ (laughs). That tells you right there. Yeah, you know it's like um, when we started I know that when um, Frankie came and watched my class I actually showed her the books we used for intervention and they would have interesting facts section and they start about like the solar system actually. And then some of the stories deal with like, planets and stuff and other ones, other stories were like about animals of the Arctic you know. And other stories…so there was always like some type of science or social studies kinda that was connected with the stories. But then when we got into this level five book, it was like, where's my interesting facts? They weren't there so I had to kinda come up with some stuff, so that's where the Wizard of Oz came in that was the story they were reading and tornadoes…so.
RJ: How have you adapted your teaching to meet local, state, and national mandates?
Jessica: Umm, we have got, um, like a no…ah…what's her name coming…because of nickelbee No Child Left Behind and stuff. The reading was just interventions like lots to do. I don't know what you guys do at senior as far as, what…huh, you laugh a lot. OK,

but I know that like, if they're coming in August because they want to make sure we're doing all our intervention programs correctly and that our reading program met the mark.
RJ: Had that person been assigned by OPI?
Jessica: Yeah, yeah.
RJ: It might be XXXX
Jessica: Not her, ah somebody else and I know her name.
RJ: Because she is doing XXX and some others.
Jessica: Yeah, so we've got, yeah they're coming and its like we always have somebody that's gonna check everything out.
RJ: How do you maximize student learning in your classroom?
Jessica: I beat em. I beat it into them. No, not really. I feel like beatin into them sometimes with the book. Read this book. Um, maximize their learning…get the best out of them I can. Everybody is so different….wow…I think one of the things I, I've learned is, for myself as a learner, I learn in a lot of different ways. My kids, they learn in a lot of different ways so you can't just read them the book, you also have to write things on the bulletin board, discuss things. There's a lot of different ways they learn. Some of them still don't learn anything because…yeah, you know that.
RJ: True.
Jessica: Hopefully that's it.
RJ: How do you describe your role as a teacher?
Jessica: Um, supportive. I think you have to really build the trust relationship with the kids. Um, I, I think too you have to set, um, some expectations for your classroom and abide by those. And I think turn the kids have some expectations too. You know I, I think one of the things that's really bothered me over the years is when you have kids naughty and you have kids who are really good, and the naughty kids take up so much of your time. And you know, you see it at senior I know, and, and its kinda like the kids who are really good sometimes fallen behind, go by the wayside cuz you're having to discipline this onery child every year so. I don't know if I told you this a while back but this year was the first year I every like, just God, let this child go to a different school and he actually did transfer and I have felt so guilty but you know my class just went so much better, you know. And I think getting the kids on your side too. You know I got one boy, his name's xxxx he was just naughty, last year he winded up missing the last two weeks of school because he threatened a teacher with a knife. Yeah, in fourth, third grade. And this year I have know problems with him and he was like one of those…hey guys Mrs. XXX is talking, be quiet. You know, you know you get them on your side I think and you just build that relationship. I think that really helps.
RJ: How do you know when your students understand a concept or content?
Jessica: Hopefully they do well on their handouts or their work plus they can also share what they know through…um verbalizing it.
RJ: How do you decide when to move on to a new topic in your classroom?
Jessica: Hum, its just kind of automatic a lot of the time. Sometimes, I think when they grasp it, like um, I'm thinking of language skills, language arts skills. They have a really tough time cuz most of my kids do…they've heard of verbs and nouns and adjavatives

but they've never done a lot of work with them cuz of where they are. And we had to go back, you know, because they weren't doing really well on the written parts or even um even in the group sometimes in the group, group things activities we did. We'd find one or two that just, oh man, just weren't getting it, what you were after. And so, I think a lot of times that you just need to be really aware of where they're at and what they're doing and, and them maybe give them a little extra help one on one, um or pull a couple kids in, have em re correct things. Um, things they don't like to do but yeah.
RJ: Last question. How do your students learn science best?
Jessica: I know they talk about one on one, er not one on one, hands on. But I think you have to incorporate that plus…a lot more.
RJ: A lot more what?
Jessica: A lot more. I think you need to incorporate the reading part of it. You also need to incorporate like group activities, and discussion. Um, I know my kids doing, like doing the KWL chart. That was a blast for them when we did that you know. We've done the thing with the hula-hoop to compare and contrast you know. We like graphic organizers. It doesn't mean they have to get a grade on it. But, also I think it helps you see where they are and what they know. So does the KWL and I did mine with sticky notes and they all had to come up with things. It's just kind of interesting to see how they did that. Experiments were really hard because they mainly do all that up in the classroom but for myself too its reading and them being able to give feedback after what we have discussed and talked about. They like PowerPoints, they also like um movies, yeah. So anything you can use to make…but
RJ: Great. Do you have any questions for me?
Jessica: No, so your working on your doctorate…almost done?

Interview 06100801
MSSP Subject: Melissa
Interviewer: R. Jones

RJ: All right, here we go. Ok, um, basically for the record all I need you to do is state your name and where you teach and what you teach.
Melissa: Ah, XXX, I teach at XXX elementary XXX grade.
RJ: XXX grade. Well XXX if you have any um, objections to any of the questions or if you any ah, questions that make you feel uncomfortable let me know and we can either skip that questions or we can just stop the interview at anytime. OK.
Melissa: OK.
RJ: I have a couple of questions that I would like to ask you about your school and your teaching. But first do you have any questions for me?
Melissa: No.
RJ: OK, sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation what influences how you teach science?

Melissa: Well, ah, the school does get in the way of it a little bit because we have so little time. Um, seems like if I teach it at all, I have to ah grab time from here or there or someplace and like I said we just don't have a lot of time for it so, that influences it quite a bit. Ah, it usually, a lot of the time I end up doing something just out of the book because I've got fifteen twenty minutes, thirty minutes and you really can't set up for anything hands on in that amount of time.
RJ: I imagine that's true. In your school do you decide what to teach an, and what not to teach or does someone else decide that for you?
Melissa: So far in science I have decided. Because like I said there's not much time for it.
RJ: Sometimes other people in the school and district can influence your teaching. Does your principal have any influence on your choice of lesson or lessons, or how you teach?
Melissa; Not in science.
RJ: So, not in science. So does he have influence on other areas?
Melissa: Oh yeah (laughs) they're very particular on reading and math, what we teach, where we are…to day to day. We have to be a specific spot every day just about.
RJ: Do you think that might be what really drives the amount of time or the limited amount of time you have in science?
Melissa: Yeah, um hum.
RJ: Ah, are there other teachers in your school that have any influence on what you teach?
Melissa: Ahh, probably not science. Ah, ah usually with science I brake away from the other XX grade. But, were suppose to be…the XX grade, is suppose to be at the same place, at the same time for the other subjects. I mean so, they, there's a lot of influence that way on other subjects, but usually science is not quite so, you know, if I have time for it.
RJ: What about parents and the community, do they have any influence on what you teach?
Melissa: Not a lot.
RJ: School Board?
Melissa: Nnnna, not a lot.
RJ: How about the other administration, not just the principal?
Melissa: (Big sigh) Like I said, ah, it, in science we haven't had too much ah say other than just…in math and reading.
RJ: Uh huh, How about national policy or rules like No Child Left Behind, does that have any influence on you or cut into you time perhaps?
Melissa: It cuts into the time. Ah, because of No Child Left Behind is why we are doing so much reading and math.
RJ: When you say, so much reading an math, how much time is spent on a daily basis on reading and math?
Melissa: Well we have a regular ninety minutes of reading and we have ah 45 minutes in the morning ah that's used for language arts and ah spelling and type stuff. And then we have WIN time, which is another 45 minutes, and all that's reading. And then we have,

in math we have an hour. Ah, and then we have another 45 minute period for math so…I mean its most of the day.
RJ: Is there anything else or anyone else that might influence your teaching at all?
Melissa: Umm, for science…not really. Like I said, at this point they haven't said you have to teach this a this time and this and that an, so I can pretty well decide, you know if I have time. Ah, there's not a lot of time.
RJ: Sometimes the physical setting and access to resources can influence your teaching and your choice of lessons. Do you have resources and materials needed to teach science?
Melissa: I have some ah, I've, I have, actually I've got quite a few. But, (sigh), I guess access to it, even though I do have it. Access to it is kind of difficult. So it makes it difficult.
RJ: Do you have adequate space?
Melissa: As far as, no (laugh)
RJ: Teaching space?
Melissa: No, that's, that's why, that what I mean by getting to it, I mean my science stuff is clear up on top of a shelf that's, I have to stand up on a chair to get to you know. And I, you know its just not fun so I don't get up there sometimes when I could.
RJ: Do you have adequate equipment to do activities if you had the space and easy access to it?
Melissa: Ahhh, sometimes, that's another thing. I haven't really gone through the kits. We've got some science kits. But, because they're so big and I have to put them some place that's out of the way, its hard to get to them to really know what's in there. And ah, supposedly the stuff that the book calls for is suppose to be in there. But, you know, when you…I've tried that before (laughs) it wasn't with this science book, but I, out of the last science book that we had, they also had kits and every time I went to do a hands on…I'd get up there and get my kits down and look through the stuff, and there was always something missing (laughs).
RJ: I understand that.
Melissa: Something that was important, I mean. So it was very frustrating. But I haven't had that with this. Like I said, I've been very careful to make sure that I have it before I do the lesson now.
RJ: OK, sometimes access to ideas and professional development can influence your teaching and choice of lesson or lessons. How has access to ideas and professional development affected your teaching and choice of lessons?
Melissa: OK, ah, this class has affected it.
RJ: In what way?
Melissa: Well, ah…I have done a lot more…activities because of this class that I am taking right now.
RJ: K, um, what benefits from participation in professional development have you observed and related into your teaching?
Melissa: Ah, I, I think it helps a great deal. Like I said, I feel more comfortable, ah doing the hands on than I felt before. Um, I usually have the materials because I've

either done it here or…ah, or I've got a better idea of exactly what its gonna need, what its gonna take to do it. And I usually can find a way of getting the materials.
RJ: OK, great. Ah, is there anything else that I might have overlooked in influences, and benefits, and professional development and that sort of thing? ….What role does the text play?
Melissa: Well, like I said, because of time constraints the text can play a big role. Because a lot of times all I have time to do is to say, OK, get your book and we'll read this, you know. And, ah, though I don't really like teaching it that way, ah, if all you've got is thirty minutes, thirty to forty minutes. You know, its next to impossible to set up and, and do anything, you know, in that short of time.
RJ: I think you already answered this question. Um, and what you just said, pretty lines up with it. And it is, what do you feel drives the amount of time that you teach a specific content, in this case science?
Melissa: (Laughs) Reading and math (laughs). I mean, cuz there's sometimes I just have to be a specific point in math. Or well, reading not so difficult. But, with math if the kids don't get it, you have to teach it until they do. So, sometimes I have to even use extra time, to re teach something that I have already taught. Which the only time I have, is the time I would normally use for science. And then it, then they get a lot of math (laughs). So reading and math is what drives it basically.
RJ: How do you decide what to teach and what not to teach in your science classes?
Melissa: Well, reading has some to do with it. Ah, because there is a section on space, telescopes, things like that. And so during that time I like to teach having, something having to do with that area. Ah, the rest of the influence has been this class basically. I have tried to teach things that I have learned here because I know a lot more about it and.
RJ: So it has given you more confidence?
Melissa: Yeah.
RJ: How have you adapted your teaching to meet local, state, and national mandates?
Melissa: I haven't worried about em at this point. Obviously.
RJ: Good. How do you maximize student learning in your classroom?
Melissa: Well…with reading. Are you talking about science?
RJ: You can interpret that question however you wish.
Melissa: Well, with ah reading its, and math its pretty well set. We have to, you know, we, there's tests, pretests…posttests in math. They are tested to death. Ah, in reading ah, there's a lot of testing, a whole lot of testing. In science I don't do that. Ah, I, ah, because we're not really being tested on it at this point, which we will start being. And then I will have to get a lot more…worried about it. But I haven't worried. I figure anything I give them is going to be that much better for them and, and I'm trying to get the testing stress off them so I give them the information and hope they've picked up on it.
RJ: How would you describe your role as a teacher?
Melissa: Ah, well, ah again with…its difficult, it's difficult on a reservation. It really is, because there's not a lot of motivation. So I spend ninety percent of my time trying to

motivate them in some way or another (laughs). And sometimes I feel like, oh man, I don't think I am ever gonna get these guys motivated. So.
RJ: How do you know when your students understand a concept of a topic?
Melissa: That's really hard. Ah, especially where I teach ah, because they are so…a lot of the time they seem so uninterested. I mean, you look at them and you can tell they are not listening. You know?
RJ: Uh huh (laughs).
Melissa: I mean (laughs), and if they're not even listening ah, its kind of difficult for them to learn anything.
RJ: That's true.
Melissa: Ah, especially when we have to teach it exactly in the way that we, you know, on some subjects, you have to teach it exactly this way. With science it's a little better because they have enjoyed the hands on and ah, and they also enjoy, actually sometimes I just give em a worksheet and say get in partners ah, find the answers. And as long as they're, ah, as long as I gone through it and showed them how to look for answers in a textbook, which I think that's a good thing too. You know they do pretty well.
RJ: Good. How do you decide when to move on to a new topic in your classroom?
Melissa: I'm told when to move on in reading and math. In science I basically ah give them…what I can of the information. Sometimes I just decide let's go. We might as well get something else. Well with the scien…astronomy one. I usually go through that unit in the book, which is about six weeks.
RJ: OK, last question for you. How do your students learn science best?
Melissa: I think they learn science best the same way that everybody does, with hands on type materials. Now, that does not necessiarly mean that they are getting a perfect understanding of it. But at least they are engaged and being engaged is something (laughs). They might not necessiarly understand exactly what, what they're, what were trying to get them to understand but ah, like I said, it, they are getting something. And, I guess that is all that really matters, that we get something.
RJ: Well especially at the grade your probably working with. You want to keep them interested.
Melissa: Yeah.
RJ: Do you have ah, any questions for me about what we're doing or anything like that before we're done?

Interview 06100802
MSSP Subject: Angela
Interviewer: R. Jones

RJ: For just the record I need to have you state your name, what you teach and where you teach.
Angela: My name is XX, I teach in XX. Um, and I teach XX grade, um science, everything (laughs).
RJ: Everything. OK, so your self contained?

Angela: Yeah (laughs).
RJ: I like that term. If at any time you feel uncomfortable with a question or the interview, or the interviewer, let me know and um we can move on or conclude the interview.
Angela: All right.
RJ: Do you hav…I have a couple of questions uh, I'd like to ask you about you and your school. And your teaching. But first of all do you have any questions for me?
Angela: No.
RJ: No, OK. Ah, sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation, what influences how you teach science?
Angela: We have a very limited time schedule. So we're maybe allowed and hour a week to teach science. Um, and so that kind of factors in um, but they don't really, like I'm pretty much free to do whatever I want in that time. Um, and I can kind of integrate it where ever I want as long as I am still teaching the math and reading, that's the most important at our school.
RJ: OK. So in your school do you decide what to teach and what not to teach?
Angela: For science yes.
RJ: But for the other subjects?
Angela: No, it's very strict on the, you have to follow the curriculum. There's a pacing calendar, so.
RJ: Does your principal have any influence on your choice of lesson or lessons or how you teach that lesson?
Angela: Ah, again for math and science (she means reading) yes, but for science, social studies no.
RJ: OK, what about other teachers in your school?
Angela: Um, we talk about the different lessons and stuff but…they don't really influence too much what you teach or how you teach it.
RJ: How about parents and community?
Angela: Ummm, even less. The community um, like some, some of the parents I've worked with a little bit and um, based on their suggestions I'll try to incorporate certain parts of the culture but that's about it as far as community.
RJ: What about school board? Do they have much say in what you do?
Angela: Ah, ah, ah, apparently no (laughs).
RJ: Apparently? (laughs)
Angela: There is some things that happened recently but not as far as the content that we teach. Its more personnel issues.
RJ: More personnel issues. OK How about district administration, that would be um, not just the principal but, like curriculum directors and things like that?
Angela: We don't have um, we do have a curriculum director for reading and math, and again that is a very strict one. Um, but as far as the rest of the content areas you know, we, it's …whenever we get a new curriculum there's a hire commt, ah curriculum committee and that stuff, but.

RJ: K, how about national policy or rules, for example No Child Left Behind, or state testing, that sort of thing?
Angela: Math and science yeah (laughs)…Or I'm, I'm sorry I mean math and reading yeah. Science is kinda the next one coming up but ah, it still doesn't really… because of the time we're given it.
RJ: How much time do you have, I mean, how much time is mandated or required for reading and for mathematics?
Angela: There's a ninety minute reading block, with a 45 minute language arts and 45 minute intervention time so that's what, three hours. Something like that and um math is ninety minutes.
RJ: So four and a half hours of your six-hour day…wow, and that includes PE and recess and all that stuff.
Angela: Yep, so.
RJ: Wow, is there anyone else or anything that might control the time that you have and the content that you teach?
Angela: The kids.
RJ: The kids?
Angela: (laughs) They impact a lot what I teach. You know, if they're interested in something then that's what I go with. Um, and then their behavior of course you know (laughs) will limit the time that you have to set up an experiment if they're having trouble.
RJ: I think we might come back to that in a little bit. Sometimes the physical setting and access to resources can influence, can have an influence on your teaching and your choice of lessons. Do you have the resources and materials needed to teach science?
Angela: I think so. We got a new curriculum, maybe…it was my first year here I think so, three years ago we got a new, the Harcourt I think it is. Its either Harcourt or Houten-Mifflin, but we got the science text books and all the kits that go with it so. And then with this class of course, you know I've got a lot of hands on stuff so.
RJ: OK, how about your space? Do you think it's adequate to teach science effectively?
Angela: It works, but I wouldn't mind bigger. It's just the reason why it's a little bit tough sometimes is I have, you know twenty-two students on average and so it gets kinda tight quarters sometimes.
RJ: What about equipment? You said kits. Are those kits complete or do they have consumables that have been used up?
Angela: Ummm, they're mostly complete. The, there's a few things that maybe I've used up. But it's the simple stuff, like um, I don't know, like tin foil or clay or, you know its easy to access. I haven't gone into the other stuff too much.
RJ: K, sometimes access to ideas and professional development can influence your teaching and choice of lesson or lessons. How has access to ideas and professional development affected your teaching and your choice of lessons?
Angela: Well since I started BSSP, that's greatly impacted my science because I wanted to kinda experiment with what were doing. So that's what I taught last year more than stuff that I previously taught so that's kinda, kinda changed a little bit.

RJ: K, that ties into the question, the next question is what benefits have your experienced from participating in professional development that have been directly been observable in your teaching?
Angela: Well there's more um, the manipulatives that we've received from here. Um, the rock kits, magnifying glasses, um, what else have I used…the, well the clay (laughs), there's been a lot of hands on things that we've gotten here that I have used. The Stories in Stones book, I've used a lot out of that one. Um, so, what was the question again?
RJ: It was…
Angela: (laughs loudly)
RJ: How has it impacted your teaching?
Angela: OK, so yeah so, pretty much you know, I got some ideas here and I wanted to try them out. So I went to the classroom and you know, brought it in and.
RJ: Were they effective for the kids?
Angela: Yeah, yep, and um it was easy to tie in the cultural stuff too with what we've been doing so.
RJ: All right. Well were clicking right through these. What do you feel drives the amount of time that you teach a specific content?
Angela: Um, of course it's expected that we follow that reading and math time that I mentioned earlier. They send people to check on you sometimes so if your not teaching it at the right time then you know. Um, we get in trouble yep um (laughs) but um, but like I said it is a little bit flexible. Like um, when Gail was coming to observe I changed around my schedule and I end up teaching science for an hour just that day, just to do a lab en do the full thing. So, if there is something special coming up or if I know I'm going to have a lab one day I can kinna switch some things around but I always have to make up what ever math and reading time I miss at another time. So.
RJ: How do you decide what to teach and what not to teach in your science classes?
Angela: This year I kind of went with um some of the things I taught previously that were on the standardized testing. Um, some of the stuff with um life science, biology that kind of stuff, um, but then the rest of it I took mainly from here like I said, just to try it out and see, to see if the kids liked what we were doing.
RJ: Good, how have you adapted your teaching to meet local, state, and national mandates?
Angela: Um, well…locally there's really not any mandates so I guess the only thing would be, you know, adding the cultural stories that I know. Um, I'm sure, well I know the community appreciates that. Um, state, OPI standards, I don't know. I mean (laughs) like, I know, I know the stuff that I am teaching is part of the standards…but I don't know, actually I never really looked at what grade level each one really hits, so.
RJ: In your binder, there's the standards and it has what they call GLE's, grade level expectations.
Angela: OK, yeah I kinda just done whatever in them, and so NCLB is just, you know that test.
RJ: That looks like the controlling factor for most everybody.
Angela: Yeah.

RJ: How do you maximize student learning in your classroom?
Angela: Ah, again, just for science? Or, Ok, um, I usually tie it into something that they know. I start with that, something that they know. Weather it's um cultural or not. Weather it's just something they observe in the world around them. But, um, then we go on to talk about what they already know and then we'll usually do a hands on um, lab that goes along with the idea and then we, if I have something in the textbook that goes along with it we'll read out of that and discuss it. Um, and then we usually have some sort of project or assessment so. They always work in groups in science. So, um well almost always, so a group thing.
RJ: How do you describe your role as a teacher?
Angela: (laughs) Woo ah, Um, my role as a teacher is to um, kinda my object right, my purpose. What your getting at?
RJ: How you see it, yeah.
Angela: OK, all right, um.
RJ: For lack of better terminology do you see yourself as the sage on the stage orthe guide at the side? I mean…
Angela: OK, sure. Yeah, I'm more the guide I guess cuz um, mean I'll, I'll be the person that explains it to em, stops, you know, what going on to make sure they're on the right track but, I like to let them explore, especially with science. Let them try to come up with their ideas. So I kind of give them what they need to get started, then let them try it and then we kind of go through it together. So it's kinna both.
RJ: Good, ah let's see. How do you know when your students understand?
Angela: Usually the, the well the way that I know the most is when they, when they start talking about it on their own. You know, they will come up to me after class, or you know the next day, hey, and they'll start talking about it. That's when I know I've got em. But, um, otherwise its usually the best way for me to know if they know it is just through talking to them, Their um, their at XX grade not always able to express themselves in writing um, so a lot of times it's just through observations you know. Can they move things around the right way, or can they talk about it, you know, then you can kinna…you can give them the vocabulary then if they need it. Cuz they can describe it but they, you know, need that assistance still.
RJ: How do you decide when to move on to a new topic in your classroom? Well with reading and math that is orcherstrated for you but for science and social studies let's say?
Angela: I kinda go unit by unit. So like, if I'm, if I'm doing the rock study, it's kinda when ever I to the end of it you know. Um, and if they, and usually, I don't know, it's usually when the students understand it or when we've gotten through the material basically. I mean it's not really time restrictive so much with science and social studies.
RJ: Good, how do your students learn science best?
Angela: Cooperative groups and hands on, those are the two big things. Cuz I have a lot of, a lot of high kids and a lot of low kids so they kinda helped each other out.
RJ: So you are in a heterogeneous grouping?
Angela: Yep, yep so.
RJ: Well that was my last questions for you. Do you have any questions for me?

MSSP Subject: Angela (continued)

Angela: I don't think so (laughs)
RJ: Well thank, that was pretty, fairly painless.

Interview 06100803
MSSP Subject: Tiffany
Interviewer: R. Jones

RJ: First off, for the record I just need to know your name, what you teach and where you teach?
Tiffany: Ok, this last year, um, I was at XXX, XX, XX grade. And, um I had everything basically except music and PE. Um, this next year XX grade at XX and I will be teaching everything but Library.
RJ: All right. If at anytime you feel uncomfortable with a question or the interview in general just let me know and we can move on to another question or we can stop the interview. OK?
Tiffany: Uh hum.
RJ: All right, I have a couple of questions that I would like to ask you about your school and your teaching. But first do you have any questions for me?
Tiffany: No.
RJ: No? OK. Sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation, what influences how you teach science?
Tiffany: Well actually, I um…thought it was most interesting when um Frankie and Gail dropped by my classroom cuz it was the beginning of the year and I hadn't really um, thought about my materials in science. So we started looking through the whole room and we found absolutely no materials in science. There was not one science book at all. At the end of the year when I cleaned out the cupboards, I found a white book that um, had been used a number of years ago. And it had about fifty pages of science ideas for first grade. And um…so…um I did know that, you know, our reading first ah was very, very um important to the school district and I did know that in my previous reading first they had a science component that was strong in the hartcourt. However, opencourt had a very weak science component and um which I noticed oh maybe once a week um but because we put an hour and a half into reading in the morning and um a strong half hour to forty-five minutes in the afternoon in to reading. Um, that's where I took some of my science from because it was all I had. I could not believe it was that bad. And there was, there wasn't even, ah a magnifying glass in the, in the cupboard (laughs) there was nothing.
RJ: When we get down to another question we will talk about equipment and we will come back an revisit.
Tiffany: OK.
RJ: Um, does your principal have any influence on your choice of lessons or how you teach?

Tiffany: Ah, well we have, lot, way more programs than I have ever seen, uh a lot of them related to discipline and a lot of them related to our reading strategies. Um, to math, we had several math programs going and we did have a nice um textbook series for social studies. But I did I did have plenty of science teaching time at the end of the day because um, social studies and science was kinda slash and open at the end of the day. Um, and I could use that time however I wanted to. And on Friday I actually had a solid hour and um, and I was just thankful, so thankful that I could use what I was learning and teach from that.
RJ: OK, great. Are there any other teachers in the school who influence what you teach?
Tiffany: Um…actually for reading ah reading is so big, that um we, all four of us, four XX grade teachers, we, we thought about our reading and stratergized it every week together. And talked about it almost every day together and pulled that together really well. Um, math was a little bit looser and science and um social studies no one monitored that all your long. No one hardly talked about it. There was another XX grade teacher that loves social studies. So at the end of the year um, we took the high kids and I took science and she took social studies.
RJ: Great. How about parents and your community?
Tiffany: Ummm…my parents were wonderful, um but since the push was reading ah that…basically what they got from the school was how the child was doing in the reading department.
RJ: Does the school board have much influence on what you teach?
Tiffany: Umm, I think they…were just happy basically with what the principal was, was doing in her programs and we were not strong with science or social studies.
RJ: What about, um, national policy or rules like No Child Left Behind? Does that have an influence on what you teach?
Tiffany; You know it will when, when science is taken, you know, more seriously on the, on the Montana testing. I, It will make a big difference because the rea, reason we were pushing so hard in reading and math is because of the third grade testing in those areas. Ah, and um, the big concern was to make AYP. And so every program and everything we did was because of AY, wanting to make AYP.
RJ: Sometimes the physical setting and access to resources can influence your teaching and choice of lessons. Do you have the resources and materials needed to teach science?
Tiffany: No. (laughs) Absolutely don't. Um, this last year, this next year I'll be in a new situation, and I'll be in XX grade and I'm um planning ahead so I'm , I'm going to…actually when I was at XX before, they did want us to stay with the standards…more with social studies and science than I noticed at XX. And I will put standards in my lesson plans there so. I actually thought that the structure was better for science, much better for social studies and science.
RJ: At XX?
Tiffany: At XX.
RJ: What about space? Do you have adequate space to teach science effectively?
Tiffany; You know I did. I had an absolutely gorgous classroom last year and I did have the space.

RJ: You mentioned already that you didn't have adequate equipment so.
Tiffany: I had no equipment. (laughs) Nothing!
RJ: Sometimes access to ideas and professional development can influence your teaching and your choice of lessons. How as access to ideas and professional development affected your teaching and choice of lessons?
Tiffany: Basically, I just used what we were learning in BSSP. And I took that to the classroom in some form or another. And, the, the students loved science and we actually had a good science year. I felt really good about it. Um, and I think a little older students and another year I will pull off what we covered this last year quite well actually. Um, so I feel good about just being involved in BSSP. It's made a really big difference.
RJ: I think that leads into this next question which is what benefits from participation in the professional development have you observed that have translated into your teaching?
Tiffany: I can't believe how much more hands-on I do. All, with every, all of my teaching and, and actually in some ways it's easier. Um, cuz you don't have papers to take home, more papers to correct and papers and boxes and all over the place. And, um, but I noticed that even with reading and math, especially math, I was um, doing lots and lots of hands-on and I noticed that math, just for the student to be able to be able to visualize the concept because we were learning, you know, ah very basic things like addition and subtraction. They were ahead of the game because of all the hands-on. So, so it it's really helping me. It's changing my st, my teaching style.
RJ: That's great. Is there anything else that influences your teaching, or ah has, you've benefited from professional development, and what not that I might have over looked?
Tiffany: Well, I, I really tried to work with the culture teacher. And, and he loved um helping us and so we were able to pull the cultural component in and um, I think I'm going to, just befriend, you know, a few people that want to come to the classroom and um help me with the cultural areas. Because that so much enriched um…the dynamics for the students, I loved it.
RJ: Cool, all right, what do you feel drives the amount of time you teach a specific content?
Tiffany: Well, um, reading first was an hour and a half in the morning and an hour in the afternoon or so. And then math was um an hour in the morning and, well let's see, math is an hour after lunch and a half hour in the morning actually. So, the rest of the day was pretty much my own. Truly it was for whatever, however I wanted to use it.
RJ: Cool. How do you decide what to teach and what not to teach in your science classes?
Tiffany: I did look at the curriculum. Um, um standards for Montana, and I (laughs) I really love the curriculum standards in, and giving that some thought. So I combined that with what I was learning, you know, form BSSP and um tried to cover both.
RJ: You mentioned working with integrating culture into it. So what else have you done to adapt your teaching to meet local, state, and national mandates?
Tiffany: Well I created so cultural lesson plans for the principal and um, that were like local cultural things like um, Crazy Head Springs and so forth. Because she needed some of those for OPI, and um, I um, took culture class ah at the college and I also took a

culture workshop that they offered. So I, I did get a lot more familiar with the culture and um feeling much more comfortable with, with, um incorporating culture in all areas. It's coming.
RJ: Good! How do you maximize student learning in your classroom?
Tiffany: Ah, it's, a lot of it is maximizing time. I um, think that's really important. Um, this year I didn't do worksheets very much. My, my whole teaching style has changed because the reading first um, was a little bit, um, more verbal than it had been. Um, with the other reading first program…um, but, um what I did with the high students is…I did have some, some science things like a dinosaur dig and some things they could work on. And with the low students I would spend that time um helping them learn to read. And it was just a beautiful combination cuz I had three centers and um sometimes I, I gave them ah a creative writing um project and I'd work with the slow, ah students with reading. But, I, I was just thrilled by the end of the year um, all the students were at least in the middle group, middle of the middle group reading. So, so it did work and um, and also the reading program, the higher readers, you just let them go (laughs) and you focus on the low readers. So it worked to give the high students the writing projects and the science projects to work on and um they just work, just enjoyed working on em in the classroom. And then I would take ah between one and three low readers and we (laughs) I'd have some treats and rewards and we'd just read. So it worked out really well.
RJ: Sounds great. How do you describe your role as a teacher?
Tiffany: Well, I've always believed that more than a teacher, I um, I'm and encourager. So I just get pretty excited about progress and um, and children feel good about themselves when they are um successful. So I'm make it obvious to them when they are successful, so they do know that they're successful and yeah, the kids were good, we had a really good year actually.
RJ: OK. How do you know when your students understand?
Tiffany: Ummm, sometimes we have a circle time and I'll ask a question, and ah it's kinda the way I evaluate something. And, um and then we go around the circle and talk about it and it works out good for XX grade. It's kinda an informal evaluation but you feedback, an, and sometimes your, your really surprised that they didn't understand something, you know. Um, and you talk about it a little more.
RJ: How do you decide to move on to a new topic in your classroom?
Tiffany: Ummm, basically I spend about a week on each topic and um…
RJ: So you've pre designed it?
Tiffany: Yeah, yeah.
RJ: All right, great, how do your students learn science best?
Tiffany: I, I truly believe hands-on and, and being able to touch and feel and ah talk about it. Um, they loved the volcano and I had a (laughs) a, a volcano that I picked up at the, whatever, store. But it opened up and, you know, and they, I mean they just, yeah. Um, we did a lot though with the internet and watching things because ah, of lack of equipment and that worked out really with them too. They found that really neat. They were pretty excited about science, yeah.

MSSP Subject: Tiffany (continued)

RJ: That's my questions for you. Do you have any questions for me now that we've gone through this?
Tiffany: Un un.
RJ: All right. Thank you very much I appreciate it.

Interview 06100804
MSSP Subject: Heather
Interviewer: R. Jones

RJ: Basically for, just for record for me. I just need to know your name, and where you teach and what you teach? And you won't be identified in any way.
Heather: OK, XX.
RJ: Where do you teach and what grade?
Heather: XX public, XX and XX grade.
RJ: XX and XX grade. OK, if at any time you feel uncomfortable with a question or the interview in general, let me know and we can move on or we can conclude the interview.
Heather: OK.
RJ: I have a couple questions I'd like to ask you school and your teaching. But first do you have any questions for me?
Heather: No.
RJ: No, OK. Sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation, what influences how you teach science?
Heather: What influences how I teach science? I just do it. (laughs)
RJ: OK.
Heather: I guess because I enjoy science and I just do it.
RJ: So in your school do you decide what to teach and what not to teach?
Heather: Right now I do…basically.
RJ: All right. Sometimes other people in the school and district can influence your teaching. Does your principal have any influence on your choice of lessons or how you teach?
Heather: Nope.
RJ: OK. How about other teachers in your school?
Heather: Nope. (laughs)
RJ: How about the parents, parents and the community?
Heather: No. (laughs)
RJ: School Board?
Heather: No.
RJ: That's great. District administration, like curriculum directors, people like that?
Heather: We don't have any of those. (laughs)
RJ: How bout, how about national policy or rules like No Child Left Behind?
Heather: Yeah.

MSSP Subject: Heather (continued)

RJ: That does have an impact?
Heather: Yeah, well, my own personal reasons yeah.
RJ: OK. Anybody else or any other entity that might have some affect on your teaching?
Heather: Well you guys right now.
RJ: OK, well we'll get to that in a minute.
Heather: (laughs)
RJ: Sometimes the physical setting and access to resources can influence um, your teaching and your choice of lessons. Do you have the resources and materials needed to teach science?
Heather: No.
RJ: Um, let's see. How about adequate space? In other words do you have a classroom that would be, that you could do science in if, if you had the stuff?
Heather: I could use a little more room.
RJ: OK. How about equipment?
Heather: (laugh) I could use a lot more equipment.
RJ: So you are fairly limited on resources and equipment?
Heather: Yeah, uh huh.
RJ: OK. Sometimes access to ideas and professional development can influence your teaching and choice of lessons. How has access to ideas and professional development affected your teaching and your choice of lessons?
Heather: Well we can't use the internet much cuz it's usually down. And ah so that is very limited and uh.
RJ: What about the BSSP? Has it had any effect, um, provided you with anything that you can use?
Heather: Oh, ideas and yeah, lots of ideas.
RJ: K. So, are there, do you see any benefits from participating in professional development, like BSSP, and, an are there any direct
Heather: That' where I've got.
RJ: Anything you've directly taken from this into your teaching?
Heather: That's were I've gotten most of my ideas and materials is from classes like BSSP.
RJ: BSSP. OK.
Heather: That's where I've gotten all my materials.
RJ: All your materials you've gotten from BSSP…
Heather: Well no.
RJ: Or ideas?
Heather: Or like other like project wet and I was involved in that conservation across bound areas and other resources like this. That's why I take these classes. (laughs)
RJ: That's why you do this, OK.
Heather: So I can get more ideas and materials.
RJ: One of the, XX, was just talking about taking an Atmosphere class from me a long time ago and I told here that there was an oceanography class that was available and she said sign me up.

Heather: Yeah, yeah.
RJ: And I gonna make, tomorrow I'm going to take about a minute and talk about those free classes that are available to teachers too.
Heather: Yeah, I've taken quite a few of them.
RJ: You've taken the atmospheric science classes and those?
Heather: That one I haven't taken.
RJ: It's a pretty good class. Um, is there anything that I might have overlooked that might affect your teaching?
Heather: I don't think so.
RJ: OK, ah, what do you feel drive the amount of time that you teach specific content? It doesn't have to be nessessarily science, but math, reading…
Heather: I think basically (clears throat) the time constrain, like when, they put in PE, which I think is a waste of time, or when they put in, you know like, they have Native American studies. When they, when they fill in those blocks and right now we don't have Friday's during the winter an just, just things that they put in, in the blocks.
RJ: So you basically you loose a day of teaching a week during the winter? Oh wow.
Heather: Right before the test.
RJ: (laugh) Is that to get ready for the test?
Heather: (laugh)
RJ: Or is it totally off the.
Heather: It's, it's why? I think it's…they said it's to save money on the school.
RJ: OK.
Heather: Save money.
RJ: How do you decide
Heather: Because they're so poor.
RJ: what to teach and what not to teach on your science classes?
Heather: Um, well this was my first year in XX grade and I basically, XX and XX grade, so I basically didn't know the curriculums so I used the textbook as a guide. And then I took off from, I used that as a guide so I knew what to teach exactly and then I went off and did other things to go with that.
RJ: Cool. Um, have you adapted your teaching to meet um, local, state, or national mandates?
Heather: Somewhat.
RJ: In what, what, wha, what have you done?
Heather: I've read the standards and I've tried ta..
RJ: That's for your own personal…
Heather: Yeah.
RJ: OK. So you adapted your teaching to the state standards for personal reasons not that it's been mandated by the state or your school district?
Heather: Yeah.
RJ: OK.
Heather: (laughs)
RJ: Well I'm trying ta…

MSSP Subject: Heather (continued)

Heather: Well because that's what I think we should do.
RJ: OK. How do you maximize student learning in your classroom…regardless of subject?
Heather: By assessing an individual, I don't know by what they…observation mainly.
RJ: K. How would you describe your role as a teacher?
Heather: Basically I'm a coach. I tell them, I just encourage em, how to find out things instead of, you know, guide em to learn.
RJ: How do you know when your students understand a content or concept?
Heather: When I see em doing it and using it an applying it.
RJ: So again that observation?
Heather: Yeah.
RJ: OK. How do you decide to move on to a new topic in your classroom?
Heather: I just move on…(laughs) unfortunately. Because I want them to um, get exposed to everything. So that later on, hopefully they can pull it up.
RJ: OK. The last question that I have for you is how do you students learn science best?
Heather: Through um, through doing it.
RJ: Doing science?
Heather: Yeah.
RJ: How would a typical science lesson look for them then?
Heather: Hands-on…um, they would be asking each other questions and talking about it, maybe drawing a picture of it or maybe acting it out.
RJ: OK, so a variety of different ways..
Heather: Yeah.
RJ: …that are interactive?
Heather: Right.
RJ: Well that's my last question for you. Do you have any questions for me now that you've been through the interview?
Heather: Nope.
RJ: All right, thank you very much.

Interview 06100805
MSSP Subject: Sarah
Interviewer: R. Jones

RJ: All right, if at anytime you feel uncomfortable with a question or the interview just let me know and we can move on or we can conclude the interview.
Sarah: OK
RJ: OK. Um, just for record I need you to state your name, where you teach and the grade.
Sarah: XX, and I taught XX grade at XX. I'll be moving to XX next year.
RJ: But a XX also?
Sarah: Yeah, I'm…no, I'll be at XX.
RJ: Oh your gonna be at XX? So they moved, it's a transfer, it's in district?

Sarah: It's in district, yes. But, yeah, when I did all the interviews…or the surveys that was for XX.
RJ: That's fine. So think about this past year though as you do you teaching.
Sarah: OK.
RJ: OK. I have a couple of questions I like to ask you about your school and your teaching. Um, but first do you have any questions for me?
Sarah: No.
RJ: OK. Sometimes schools and districts make it easier for teachers to teach science and sometimes get in the way. Thinking about your teaching situation, over the last year, what influences how you teach science or how you taught science?
Sarah: Well, scheduling. And we ha, had, you know, little time each week and then we have to follow our district benchmarks.
RJ: OK. Ah, in you school do you decide what to teach and wa, what not to teach?
Sarah: Kinda. Um it's all, it's kind of all done through our benchmarks and state standards but the concepts, how we go about teaching the concepts is us, up to us.
RJ: Um, does your principal have any influence on your choice of lesson or lessons or how you teach?
Sarah: Not really, just the scheduling again is his only input.
RJ: Oh K. How about other teachers in your school?
Sarah: Well, um, the other XX teacher and I we work together. En so, I guess we influence each other just so we could help make it easier for both of us to teach.
RJ: K. How about parents and the community, do they have any influence on your teaching or what you teach?
Sarah: Uhh…yes, in the fact that I tried to bring in the Crow culture into the science. But, other than that…
RJ: Other than that not really?
Sarah: Yeah.
RJ: OK, how about your school board?
Sarah: No.
RJ: How about national policies like No Child Left Behind, does that influence on how you teach or what you teach ?
Sarah: Yeah…um, mostly because of No Child Left Behind were focusing all on…reading and math which leaves less time for science. Now that science is going to be tested, now they're trying force us, you know, to make sure we cover all the standards and everything so.
RJ: How much time do you spend teaching reading and math?
Sarah: It's, it was from 9 to 10:30 in the morning and then from 12:30 to 1:15 in the afternoon.
RJ: That was just reading or both?
Sarah: That was reading. And then math was from 10:30 to 11 and then from…um…the afternoon, sometimes we had a half hour block right after lunch. Sometimes we had to move it behind library, whatever but…half hour before, half hour after.

RJ: Just thinking about next year if we're going to be assessing science, where's it gonna fit, what's gonna, where's that time gonna come from?
Sarah: were hopping it comes from, um reading time. (laughs) we're. the teachers we'd all like ta get rid of some reading time. (laughs)
RJ: Is there anyone else that might influence your teaching that I didn't cover?
Sarah: Naa, not that I can think of.
RJ: OK. Sometimes the physical setting and access to resources can influence, can have an influence on your teaching and the choice of lessons. Do any, do you have the resources and materials needed to teach science?
Sarah: Ah, yes, our school is actually pretty good. We have, um complete FOSS kits that go along with our, we got brand new textbooks and they just ordered the lab kits for the textbooks so were pretty well furnished I think.
RJ: OK. Um, do you have adequate space to teach science in your classroom?
Sarah: No. (laughs) Because we have all this stuff ordered now we have to store it somewhere and then to find extra space ta have extra tables for labs and stuff, it's hard. We move stuff around a lot.
RJ: Umm, sometimes access to ideas and professional development can influence your teaching and your choice of lessons. How has access to ideas and professional development affected your teaching and the choice of lessons you use?
Sarah: Well, taking this class…is, I spent a lot more time on Earth Science last year just because that's what we were doing in here…so I guess, time wise I focused more on what I was learning about myself.
RJ: K. And which goes along with which benefits from participation in professional development have you observed in your teaching? In other words, how has the experiences you've had tied into your teaching?
Sarah: It's given me more research, resources and knowledge and I'm better able to teach the Earth Science now.
RJ: So next year, your gonna be covering, it looks like astronomy and weather. So how do you, do you know how that will fit in to you XX grade cur, curriculum?
Sarah: Yeah, I just got done writing benchmarks, or essential maps last week (laughs) and with XX grade we do get to spend time on weather and astronomy so ah…
RJ: It will dovetail nicely.
Sarah: Yeah, it will work really well.
RJ: So, let's see, is there anything else that I might have overlooked that ah, professional development has done for your teaching?
Sarah: No.
RJ: No? OK, What do you feel drives the amount of time that you teach a specific content?
Sarah: Ah, if I see the kids grasping what I'm teaching then we move on. So, watching them, and also um, well are, the essential maps we just made, we kinda split em up by quarter. And so were gonna see what we can get done in, in…that test again. We need to make sure we get things covered before the test. So, I guess that's how we schedule.
RJ: How do you decide what to teach and what not to teach in your science classes?

Sarah: By the benchmarks.
RJ: And these are district benchmarks?
Sarah: Um hum.
RJ: OK, um, how have you adapted you teaching to meet local, state, and national mandates? You mentioned earlier about integrating Crow culture, are there any other things that you've done ta meet these mandates or needs?
Sarah: Besides the Indian ed, or…well, just being aware of the standards and the benchmarks I just make sure I get them covered, so.
RJ: Do you ah, do you have, like a check list that you have to turn in at the end of the year or anything?
Sarah: We keep diary maps, curriculum maps and so those can be accessed by administration and whoever wants to see em. So we, we have ta…last year we just did math and this year we have to do math and science, so.
RJ: How do you maximize student learning in your classroom?
Sarah: What do you mean?
RJ: How do you, how do you get the most out of your teaching…so tha, that there's a lot of learning going on? What do you do in the classroom?
Sarah: Ummm.
RJ: To make sure that their, well I mean one of the ah, additional questions is to make sure that they are getting it. But you, you only have twenty minutes let's say.
Sarah: Yeah,
RJ: How do you maximize that time?
Sarah: I make sure I'm prepared and have everything ready so we can get started and get going. And I make sure I know exactly what I want them to accomplish. And I get, so my preparation is big, and them um, I start the year off, you know, doing the teach toos…this is how we do things so then that helps the class know exactly how to stay on task and…and we don't read a textbook. We (laughs) we do more of the hands-on and exploring an, and questions and…um, I don't know what else…oh, peer, I do a lot of, they help each other, um.
RJ: How would you describe your role as a teacher?
Sarah: My role as a teacher?
RJ: Um hum.
Sarah: In science I guess it's more, my classroom is a lot of student lead and I…go around and help when needed, so I, I don't stand an d lecture, it's more, this is what were gonna accomplish, how are you gonna do it, so it's more student lead.
RJ: Great. How do you know when your students understand a content or concept?
Sarah: My easiest way to do that is, can you explain it to someone else, can you go over and help this kid…who, who isn't getting it…and so I walk around and I never sit an I'm always listening in on their conversations en, so if they can explain it to someone else then…I think that got it.
RJ: Great. How do you decide when to go on to a new topic in your classroom?
Sarah: Well…sometimes it's the end of the quarter and we were forced to move on (laughs) And (laughs) otherwise the idea is when ever, the whole class is, is you know at

MSSP Subject: Sarah (continued)

a good point…where either everyone's understanding it or most of em are and there's a couple who are almost there.
RJ: OK, last question for you. How do your students learn science best?
Sarah: By the exploring… I really like the FOSS kits, even though they're kind of dull and boring to look at. (laughs) They're, they're very, you know, the kids are right into it and they get to make the discoveries so.
RJ: When you say dull and boring to look at what do you mean?
Sarah: Oh they're not…they're very, they are very scientific looking. I mean it's all black and white there's no cute pictures, there's no (laughs)
RJ: And you were teaching?
Sarah: XX grade,
RJ: XX grade, they need color?
Sarah: Yeah, they need that, making it interesting to look at (laughs).
RJ: Now I have one last question and that is do you have any questions for me now that you've gone through the little interview?
Sarah: No.
RJ; No. All right, well thank you XX I appreciate it.

Interview 06110801
MSSP Subject: Michelle
Interviewer: R. Jones

RJ: Basically what I need you to do is to state your name and where you teach and what you teach for the, for the record for me. You won't be identified in any way in my transcript.
Michelle: XX and I teach at XX school and I teach XX grade.
RJ: So you teach pretty much everything there at XX grade?
Michelle: Um hum.
RJ: OK. If at any time you feel uncomfortable with a question or with the interview in general let me know and I can move on or we can conclude the interview.
Michelle: OK.
RJ: OK. I have a couple of questions I would like to ask about you, um you school, your school and your teaching. But first do you have any questions for me XX?
Michelle: No, but I might as we go along.
RJ: OK, that's great. All right, sometimes schools and districts make it easier for teachers to teach science and sometimes they get in the way. Thinking about your teaching situation, what influences how you teach science?
Michelle: My schedule.
RJ: Your schedule?
Michelle: My schedule, uh hum, um, the past year I got in more science than I have in the past couple years because I'm going to school and I'm more comfortable for what I'm teaching…other than what, what's there for before. Anything that came up, the first

thing to go was science and social studies. (clears throat) I didn't let science go, I, I got it in.
RJ: OK. Um, sometimes other people in the school and the district can influence your teaching. Does your principal have any influence on your choice of lessons or how you teach?
Michelle: Not right now (laughs)
RJ: Not right now?
Michelle: I have had, ah administrators that have, my past administrator was highly…motivational and she kept us…we needed to get this done now. This principal is more of a figurehead. (laughs)
RJ: How about other teachers in your school?
Michelle: Emmm…I think um, I'm ah, the teacher that's been there the longest and I kinda influence them. (laughs)
RJ: How about your community or your parents. Do they influence anything that you teach?
Michelle: Well this is the first year that I really took notice where par, I had a couple parents that came in and wanted to know what we were doing in science and that. And out of my twenty some odd years, that I have taught, that is the first time that my parents came in and asked.
RJ: Interesting. How about your school board?
Michelle: We do not have a school board.
RJ: Oh, OK. Um, how about the dist, within the district are there other administrators that might have any influence besides the principal?
Michelle: We have a director of schools that's um, coming in and implementing some new curriculum.
RJ: What curriculum areas?
Michelle: In math and reading.
RJ: And why is that?
Michelle: (clears throat) I really don't know because ours, our reading and our math series was working. Out of the three schools that are under XX, XX had the highest scores and it was working. So I don't know why they're changing it.
RJ: There, would there be anyone else that might influence what you teach and how you teach?
Michelle: I think, this year I found out that the donors, the people that give to XX have a big influence.
RJ: In what way?
Michelle: I think that's why they're implementing these new curriculum.
RJ; Oh, OK. Sometimes the physical setting and access to resources can influence your teaching and your choice of lesson or lessons. Do you have the resources and materials needed to teach science?
Michelle: On a small scale I do. Um, I have bins that have been prepared before hand by a previous science teacher. And they have really come, come in handy. But as far as my space (laughs) I have, my room is small and it's crowded.

MSSP Subject: Michelle (continued)

RJ: That would have been the next question, do you have adequate space to effectively teach science?
Michelle: No, not really.
RJ: OK. How about equipment, other than what's in the bins?
Michelle: Nnn, well I have my microscopes that I got from this, you know, the program and that. But other than that I, en the rocks and stuff I've, that has been furnished…but other than that no.
RJ: OK. Sometimes the physical setting and access…ah, we already did that. OK, sorry about that. Sometimes access to ideas and professional development can influence your teaching and your choice of lessons. How has access to ideas and professional development affected your teaching and your choice of lessons? For example, the BSSP?
Michelle: Well that has really kinda upgraded my science teaching with like implementing plate tectonics, and just, just Earth Science stuff that I kinda said oh, OK we'll teach it, but it was more like, like um, bandaid to a great big old wound. (laughs)
RJ: Em hum
Michelle: And na, and I'm able to, to really get in to it with a, with my students now, so.
RJ: That's great. Ah, right let's see, Ahh…what benefits from participating in professional development have you observed in your teaching or have…gone directly into your teaching?
Michelle: Well, like I said, the plate tectonics that I, I really enjoyed doing with my students on na, you know at their level and that and It…like I said, I am more comfortable to something than before.
RJ: Because you are participating in this?
Michelle: Uh huh.
RJ: And you're back in college in a sense?
Michelle: Uh huh, uh huh, so now.
RJ: So you've, you've enrolled in the MSSE is that, the Masters in Science ed?
Michelle: Uh huh.
RJ: Is there anything else that I might have overlooked that you feel have, ah the professional development involvement or other aspects that have influenced your teaching?
Michelle: Well, I think the support of the staff, they you know, they're readily available, when I need them they're right there. You know, I can get a hold of them and if I have questions, maybe if I stumped for an idea they're there, and you know they're, they're making themselves available so that really helps too.
RJ: That's great. OK. What do you feel drives the amount of time you teach a specific content?
Michelle: Say that in a different way.
RJ: Wha, what do you think, what do you think it is that, that drives the time that you spend on English or the time that you spend on math or on reading or on science?

Michelle: I value what they learn, what, what the students do. I, I want them to learn. I want them to achieve, um, I came through this system and I feel that everyone of them is capable of going through and making a better life for themselves.
RJ: OK. How do you decide what to teach and what not to teach in your science classes?
Michelle: Well I've been going by the book (laughs) that really determines my teaching. But, except this year I kinda went off and done more Earth Science than usual.
RJ: Is that book ah, a book that was purchased by the school district for…
Michelle: Yes it was.
RJ: OK. How have you adapted your teaching to meet local, state, or national mandates?
Michelle: Well, I've looked at the state and…my test scores (laughs) and I've, I've really tried to… I've looked at, over, looked at the test and thought, well I need to remember to cover these. I don't right it down because we're not suppose to so but, I usually, you know, kinna make a mental note, these things I need to cover for their sake if they are going to be tested on those.
RJ: It, it's, is your school part of the No Child Left Behind? Or are you exempt because you're a XX school right?
Michelle: Yes, but we do, we do, do the MontCas and we do, do the Iowa basic skills.
RJ: Same kind of testing?
Michelle: Just to, Uh huh.
RJ: Sure, OK. How do you maximize student learning in your classroom?
Michelle: I think from becoming like, you gotta do it this way because this is the way I'm teachin it, to, to I openin up and I, an I say OK this is what I'm saying, what are you, what are you, I question them, I ask them, what are you, what are you hearing me say. What did you hear me say? And we talk through.
RJ: So you are seeing a change in your approach to teaching, is that tied directly, do you think to the MS, the BSSP, or…
Michelle: It has helped. It has really helped. I think I was a point where I'm , where I was saying, you know this isn't working, and then I got in the program and that has, just by example, has helped me change my teachin style.
RJ: How do you describe your role as a teacher?
Michelle: How do I describe…I guess, I'm not there yet, but I want to be like a facilitator instead of demanding stuff. To facilitate their learning, to bring them in on their own learning and, and finding, finding out that these are there for them to learn. Instead of, you gotta learn this (laughs).
RJ: Um, how do you know when your students understand a topic or content?
Michelle: Just by how we can talk about it. How, if, if they have an understanding of it. And they, they want to talk about it, then they have their knowledge that they put in and…mostly, mostly that. I mean we can give a written test and that measures it, but…if I remember I took I written tests, I remember them, but talk to about a couple months down the line, I'd have to really try to jog my memory to remember what they're talking about. So, I try talk with them, and say this is, this is what I'm saying, do you understand it? Do, wha, what do you understand? And I try to get them to tell me what they understand.

MSSP Subject: Michelle (continued)

RJ: That's great. How do you decide when to move on to a new topic in your classroom?
Michelle: Time! (laughs) It's always that pressure of, we gotta get this, this done, and this done and, and ah like this year I wasn't even ready to end the school year (laughs). I wanted to keep teachin, but we were…
RJ: Wha, what, when you talk about time what takes, takes most of your teaching time up?
Michelle: What takes it? Reading and math, reading and math, we have to hit those really hard. An, like we have, like from 8:30 to 11:30 is language arts, reading assigned. And, I feel we could shorten that up, but that's just, you know, they want us to hit that reading and language and all that really hard. And then I, then I only have an hour for math. And them what's left is…(laughs).
RJ: Everything else.
Michelle: Uh Huh, whatever else I can fit in, so.
RJ: Last question for ya, how do your students learn science best?
Michelle: With hands on, hands on, when, when I do the investigations, the experiments and um, the book's set up where we do the investigations and experiments first, with their no book knowledge. And then, then we come and we read about it. And that really helps them understand the concept better.
RJ: Wha, what is the book series?
Michelle: You had to ask me that (laughs).
RJ: Well it's an interesting approach. That's not typical.
Michelle: Uh Huh, umm, I can't even think.
RJ: Well it, its not that important, but , that that approach is unusual in a standard textbook so.
Michelle: Uh Huh.
RJ: But that's a typical learning cycle model, to explore it first based on your knowledge and then you go back and about it. Um, that's all the questions that I have for you. Do you have any questions for me now that we've been through the, ah… interview?
Michelle: Uh, no, not really.
RJ: All right, than you very much XX, I appreciate it and I, I really look forward to including your comments in my…

Interview 06110802
MSSP Subject: Kimberly
Interviewer: R. Jones

RJ: Before I get started I just need you to state your name and subject and your, your school.
Kimberly: XX, XX elementary, XX.
RJ: OK. If at any time you feel uncomfortable with a question or the interview in prog, progress, um process, you just let me know and we can move on to another question or conclude the interview, OK?

Kimberly: OK.
RJ: All right. I have a couple of questions I'd like to ask you about your school and your teaching. But first do you have any questions for me?
Kimberly: No.
RJ: All right great. Sometimes schools and districts can make it easier for teachers to teach science and sometimes they can get in the way. Thinking about your teaching situation, what influences how you teach science?
Kimberly; Time, um or lack of time because I'm ties to the IEP, so everything I do has somehow fit into the IEP. So I have to find, what I did last year was use science in reading. With my reading, because most of my IEP's are reading or math oriented. I use science in there to teach reading skills and develop some…
RJ: Uh Huih.
Kimberly: And develop some ah, organizational skills…so the kids could do their, learn to organize their writing and read for diff, read, learn how to read for the content in a different way other than just fictional stories (laughs) all the time.
RJ: All right, ah in your…
Kimberly: We used it for interest too.
RJ: Interest, OK. In your school do you decide what to teach and what not to teach or is it tied directly to the IEP?
Kimberly: A lot of it, a lot of, I'm , I can do, I can…decide what to teach, but what I teach has to be tied… to the IE, the IEP. The materials are mine to choose, but it, it has to be tied somehow to the IEP.
RJ: Does your principal have any influence on your choice of lessons or how you teach?
Kimberly: A little bit, um, yah a little bit.
RJ: All right, how about other teachers in your school?
Kimberly: Some of them yes! Some of them stick directly to the Montana reading first format and want me to do a lot Montana reading first, and other say, do it any way you can.
RJ: OK. What about your parents and the community?
Kimberly: I don't think the community does. Um, my parents are pretty, pretty good and say what I'm doing is Ok with them for the most part. Just as long as their child is progressing and not lagging behind.
RJ: Well and you're tied to an IEP, so there, you know, there's annual reports.
Kimberly: Yeah, yeah.
RJ: What about the school board? Does the school board have any say?
Kimberly: Not that I know of. (laughs) Oh, they've never come to me and said, you're doing it wrong.
RJ: What about district administration other than the principal?...Is there a special ed coordinator?
Kimberly: There is a special, there is a special ed director. And he and I touch base, but he hasn't really said I doing anything wrong, in fact he's looked at some of it and said, go girl, so.
RJ: How about national policy or rules like No Child Left Behind?

Kimberly: I haven't really noticed anything.
RJ: OK, any one else that might have uh some influence on what you teach or how you teach, when you teach?
Kimberly: Some of the classroom teachers do. And, ah, I've had some questions this year, how come you are doing science when you're suppose to be doing…reading and duh, duh, duh…reading and math. And I just say, hey science is re, science is reading so. And the kids inj, the child seems to be interested in the science aspect of the thing. So we break it and go off in a tangent.
RJ: I think that's pretty good. Sometimes the physical setting and access to resources can influence your teaching and choice of lessons. Do you have the resources and materials needed to teach science?
Kimberly: No.
RJ: OK.
Kimberly: Developing them yes, but no, don't have the resources.
RJ: Do you have adequate space?
Kimberly: Yes.
RJ: What about equipment?
Kimberly: No.
RJ: What do you need equipment wise to make it effective?
Kimberly: Ummm…basic, um, just the basic science equipment, microscopes and the time to do it. And maybe a good…current textbook would be good in general ed classes ta, and for me to have a good, a good general science textbook probably.
RJ: OK. Sometimes access to ideas and professional development can influence your teaching and choice of lessons. How has access to ideas and professional development affected your teaching and your choice of lessons? For example, your participating in BSSP.
Kimberly: I think I've put more science into my less, in to my li, my um, tried to put more science into my program last year than I have before. Um, and having access to the materials since we gotten them, to, ta be able to use them in the classroom.
RJ: When you say materials, what kind of materials have you gotten?
Kimberly: The student kits, the rocks, the rock examples, the, the textbooks that have lessons planned out in them ta, that I can modify for my kids. One, one example was with my kids this year, I did the crystallization…models, and my kids, my kids loved it once they figured out how to do it. To build their own models, and then we did ah cryst, salt crystal experiment and that type of thing.
RJ: Great. What benefits from participation in professional development have you observed in your own teaching?
Kimberly: Having the teacher contact and seeing how other teachers do things. That's what I really like.
RJ: OK, great. Is there any…
Kimberly: And then more of an influence on science, (laugh) my gaining a better understanding for, of science for me.
RJ: Good, OK. Is there anything else that I might have over looked?

Kimberly: I don't think so.
RJ: What do you feel drives the amount of time that you teach a specific content? I mean you, obviously the…
Kimberly: The IEP.
RJ: the IEP, but outside of the IEP?
Kimberly: Um, District policies and the for, and the force on reading. Um, which is also, force on reading and math, which is also part of the un, the No Child Left, Left Behind, but just the district policies to keep the kids, get the kids reading by… third grade or whatever. Keep up the reading level.
RJ: How do you decide what to teach and what not to teach in your science classes?
Kimberly: I look at the interest of the kids, see what the, the students, my students are interested in. And hopefully focus on, if there is a story about a volcano, which there was last year in one of my classes. We built volcano (laughs).
RJ: Um, how have you adapted your teaching to meet local, state, and national mandates?
Kimberly: I think I've become more awar, the sta um…of the CRT and how, and the standards have…knowing what the standards are have really helped…in getting my kids more, more prepped for that.
RJ: How do you maximize student leaning in your classroom?
Kimberly: Two weeks at a time (laughs), take their interest and build it as long as it stays with one project or um a story, chapter stories.
RJ: How do you describe your role as a teacher?
Kimberly: I see it as ah, working along side my collegues rather than independence of special ed. Special ed is over here, and they, what they are doing in they're general ed is here. I see it as working with the general ed… teacher in, together ta get the child to where they want. And I've had a really good opportunity last year with XX especially, um, in working cohesiveness, side by side, I'm not a lone ranger, I work with the classroom teacher (laugh).
RJ: OK. How do you know when your students understand a concept or a content?
Kimberly: They say, I got it! (laugh) If a student say I have it, and there's that ah ha click that…and it goes on. It go, it ge, the click, the click stays with em and so they've got it in their…
RJ: Great. Ah, um, How do you decide to move on to a now topic in your classroom? You said, you know, two week block, but how do you know when your ready to do that?
Kimberly: When the, when the child had, when the child has either shown me that they are no longer interested in the topic…or um, especially with the, my younger kids, and the National Geographic Explorer that I used this year. We moved on according to the story and that just like, covered the whole issue in the month time.
RJ: K. Last question I have for you is how do your students learn science best?
Kimberly: Hands on…definitely, very much hands on.
RJ: Any…
Kimberly: And small discussion groups.
RJ: Small groups, OK. What other ways do you think?

MSSP Subject: Kimberly (continued)

Kimberly: Um, doing the activities is, is, is basically the, cuz I have trouble getting them to write things down and there is a lot of discussion. And um, building models, building things and observing the crystal formation that there drawings was really interesting for them to do.
RJ: Great! That is my last question for you. Do you have any questions for me?
Kimberly: Do you have, do you need any more forms from me?
RJ: I've got, I think seven.
Kimberly: I got one final one in May, but.
RJ: If you want to send me one that's fine.
Kimberly: OK.
RJ: It's not critical.
Kimberly: OK.
RJ: Because I would rather have you be well and I will just make do with what I have.
Kimberly: OK.
RJ: All right. Thank you very much XX, I am glad to see that you're with us, I'm really happy that you're here.