

CHARACTERISTICS OF ADVANCED PLACEMENT ENVIRONMENTAL
SCIENCE READING TEACHER PARTICIPANTS AND THEIR PERCEPTIONS OF
THE READING AS A PROFESSIONAL DEVELOPMENT EXPERIENCE

By

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2005

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This dissertation is dedicated to all the students I have had the pleasure of teaching. You taught me so much. It is also dedicated to the faculty at Buchholz High School and my professors at the University of Florida who taught me a lot about science, pedagogy, and life. Finally, this dissertation is dedicated to my husband, Gary, who has always encouraged me to pursue my dreams and supported me in that pursuit.

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Sixty percent of American high schools offer one or more Advanced Placement courses, and several thousand Advanced Placement teachers serve as Readers or graders of Advanced Placement exams each year. This study was conducted to determine the characteristics of teachers who choose to participate in Advanced Placement Environmental Science Readings and determine how these teachers view the Reading experience as a form of professional development.

This study was conducted with teacher participants at the June 2004 Advanced Placement Environmental Science Reading. Sixty of the 114 teacher participants completed a survey regarding their education background, age, experience level, educational philosophy, involvement in professional development opportunities, perceptions of the professional benefits of the Reading, and the influence of the Reading experience on their pedagogical practices.

Semi-structured interviews were then conducted with a subset of 18 teacher participants to determine their perceptions regarding the professional benefits of the Reading experience, its potential to serve as a professional development activity, and perceived changes in their pedagogical practices resulting from participation in the Reading process.

Results indicate that APES Reading teacher participants are experienced, effective teachers from many parts of the country. These teachers participate in ongoing professional development activities, can delineate components of effective professional development, strongly believe that effective professional development occurs at the APES Reading, and report that their pedagogical practice has improved as a result of participation in the APES Reading. Considering the crucial role teachers play in the educational process, it is important to pursue this additional avenue of professional development in order to further improve APES teacher effectiveness.

CHAPTER 1 INTRODUCTION

A recent national poll of 800 registered voters found that Americans view improving teacher quality as the number one way to improve schools (Deily, 2002). A report from the National Commission on Teaching and America's Future (NCTAF, 2003) also indicated that the quality of America's schools depends on teachers' competency and commitment. Harvard researcher Ronald F. Ferguson estimated that money spent to increase the quality of teachers produced the greatest gains in student performance (Deily, 2002). Therefore, increasing teacher effectiveness is crucial to improving and reforming America's schools.

Two main vehicles for improving teacher quality and effectiveness are initial teacher preparation (preservice education) and professional development activities for practicing teachers (inservice education). This study focused on the potential of the Advanced Placement Environmental Science (APES) Reading experience to serve as a professional development tool by assessing characteristics of Reading participants, perceived professional benefits of the Reading to teacher participants, and perceived professional practice changes reported by teachers as a result of attending the Reading.

This chapter discusses the following topics in introducing this study: a history of the Advanced Placement program, purpose of the study, research questions, rationale for the study, overview of the study design, delimitations, limitations, and a summary of chapters.

History of the Advanced Placement Program

A brief history of the Advanced Placement (AP) program is important in understanding this study because the study sample chosen for this research focused on an APES Reading and the AP teachers involved in that Reading experience. This history is also helpful in understanding how professional development can influence teaching in the AP program. Literature regarding other areas of significance to the study, including effective professional development and characteristics of effective teachers, is reviewed in Chapter 2.

In 2002, AP courses were offered in 14,157 high schools in 98 different countries. This included almost 60% of the high schools in the United States. Ninety percent of the colleges and universities in the United States and Canada give college credit, placement, or both for qualifying AP exam grades. Colleges and universities in 20 additional countries also offer credit for qualifying AP exams. This information indicates that AP is an influential component of education in the United States and other parts of the world.

The AP program began in the 1950s. It was established to help solve the problem of academically able students receiving the same coursework in college that they had already completed in high school. The AP program also enabled these students to pursue (and obtain credit for) college-level coursework while still in high school. The AP program offers 34 different courses in 19 subject areas, including several courses in the area of science. The AP science courses include biology, chemistry, environmental science, and physics (AP Central, 2004).

In 1955, 1,229 students in the United States took AP Exams and by 2000 this number had grown to 845,000 students (Santoli, 2002). In 2002, there were 1,585,516 exams taken. Since exams were first administered in 1956, more than 10.5 million

students have taken more than 16 million AP Exams worldwide. Over 1,400 colleges and universities have granted a full year's credit to students, enabling them to gain sophomore standing upon entering a post-secondary institution (AP Central, 2004).

The AP program is sponsored by the College Board. The course guidelines and AP exams are developed by a committee of college faculty and AP teachers. Almost 3,000 colleges and universities worldwide grant college credit to students who perform satisfactorily on various AP exams. In May of each year, the Educational Testing Service (ETS) administers AP exams at participating schools and multi-school centers. Approximately 63% of students taking AP exams each year receive a grade that is recognized for college credit, AP credit, or both. Possible scores on the exams range from 1 (lowest) to 5 (highest). Most colleges who recognize AP courses for college credit award credit to students obtaining a grade of 3 or higher on the exam (College Board, 2001; AP Central, 2004).

With the exception of AP Studio Art (which uses a portfolio assessment), AP exams are composed of multiple-choice and free-response sections. The multiple-choice portions of the exams are sent to the Educational Testing Service (ETS) in Princeton, New Jersey for automated scoring. The students' free response booklets are sent to various Reading sites, usually located on university or college campuses. In June of each year, the free-response sections are evaluated by teams of high school AP teachers and college professors who teach the comparable college subject. The ETS is responsible for organizing the grading of the free response booklets. During the Reading process, readers are divided into groups, with each group grading one of the free-response questions (College Board, 2001; AP Central, 2004).

The Advanced Placement Environmental Science course was first offered for AP credit in the 1997/1998 school year. The first Advanced Placement Environmental Science (APES) Reading was held in June of 1998 for the grading of the free-response portion of this first APES exam.

Purpose of the Study

The overall purpose of this research study was to determine if the APES Reading experience serves as an effective professional development activity and thus provides the potential for increasing teacher effectiveness. Because of the documented effect of teachers on student learning, the desire and need to improve pedagogy is at the base of our educational system (Deily, 2002; NCTAF, 2003). Since AP is a growing part of secondary education in America (60% of American high schools participate), the potential influence of the Reading on teachers, teacher effectiveness, and thus student learning needs to be researched.

There were three areas of focus for this study. The first involved identifying general characteristics of teachers who choose to participate in the Reading. Because APES has only been offered in secondary schools for 7 years, little is known about the general characteristics of this particular group of teachers. What are their educational backgrounds, ages, experience levels, and general educational philosophies and practices? What are their views of professional development? Do they demonstrate an interest in continuous professional development via ongoing participation in professional development activities? Do they possess common characteristics, and do these characteristics differ from current research on the characteristics of teachers (or effective teachers) in general? Identification of these characteristics can facilitate the design of

professional development activities that are tailored to the needs of this group and provide the greatest potential for increasing their effectiveness as teachers.

The second area explored participants' views of beneficial aspects of the APES Reading. This part of the study focused on veteran APES teachers who viewed the Reading as beneficial to them professionally and therefore view the Reading as a positive professional development experience. In addition, this area sought to identify what features of the Reading they perceived as beneficial to them professionally, how these areas were beneficial to them professionally, and why they perceived them as beneficial.

The third area investigated how veteran APES Reading teacher participants perceived their teaching practice had changed as a result of participation in the APES Reading. If teachers reported that the Reading was beneficial to them, they were asked to identify specific changes in their pedagogy that they attributed to participation in the APES Reading experience. Because the goal of professional development is to improve professional skills (Blackwell, 2004; Cardellichio, 1997; Kindsvatter, Wilen, & Ishler, 1996; Stronge, 2002), it is important to know if teachers perceive they have changed their professional practice as a result of participation in the Reading experience. Can they delineate those perceived practice changes and articulate why they have changed them?

Research Questions

The specific research questions addressed in this study were as follows:

- Research Question 1: What are the characteristics of teacher participants at the APES Reading and what are the characteristics of veteran teacher participants who view the APES Reading as a positive professional development experience?
- Research Question 2: For veteran teacher participants who view the Reading as a positive professional development experience, what aspects of the Reading do they perceive are most beneficial to them?

- Research Question 3: For veteran teacher participants who view the Reading as a positive professional development experience, how do they report their professional practice has changed as a result of participation in the Reading?

Rationale for the Study

Based on my previous participation in the APES Reading and professional development activities, I believe the APES Reading has a valid purpose other than just the grading of the essay portion of the national exam. I also believe the Reading has the potential to serve as an effective professional development activity for participants. During my participation in the APES Reading, I increased my knowledge of various environmental science areas; broadened my pedagogical techniques as I incorporated ideas from other participants; gained understanding about the misconceptions of many of the students who took the exam; and was exposed to possible ways to deal with these misconceptions. I discovered additional teaching resources that were helpful in conveying different concepts to my students and I developed a network of teachers that functioned as both a resource and a support system. If the Reading is indeed an effective professional development activity, it behooves the Educational Testing Service and College Board to know the characteristics of teacher participants at the Reading experience and understand how the Reading experience facilitates the professional development of environmental science teachers.

Verifying the characteristics of APES Reading teacher participants can enable school districts, and even the College Board, to determine the types of teachers that would benefit most from their experiences as APES Readers. This could help guide school districts in their decision making about which teachers to send to the Reading and what to expect those teachers to gain from participation in the Reading. Identifying the specific aspects of the Reading that participants see as most beneficial to them

professionally could help the Educational Testing Service and the College Board identify changes in the design of the Reading. These changes could broaden the experience and make it even more effective as a form of professional development without undermining the primary purpose of grading student essays.

Due to the limited amount of existing research related to the research questions identified for this study, the study was exploratory in nature and was not designed to produce generalizable, quantitative statistical results. Such a study would require a large randomized sample of APES teacher Readers. Instead, this study focused on a sample of APES teacher Readers from one summer Reading session (June, 2004) using qualitative data from surveys and interviews. I anticipated from the beginning that the exploratory nature of this study might generate more questions than it answered.

Overview of the Study Design

The design chosen for this study was based on my understanding of qualitative research, case study design, and my conviction that these were the best methods to use to explore the proposed research questions. Based on a review of literature, I determined the most appropriate qualitative methods for use in this study were surveys of APES teacher Readers and semi-structured interviews from a subset of this same group. I designed survey and interview instruments to address the specific research questions of the study.

All of the data were collected during the Reading because of recommendations made by qualitative researchers that emerged during the literature review. This concentrated collection time provided a study sample of information-rich participants and enabled me to survey an entire APES teacher Reader group. Including the entire group provided the potential to obtain a clearer picture of one particular Reading experience. Because of the relative newness of the APES Reading, repeated involvement of many

Reading participants, and the small number of APES Reading participants each year, this one Reading experience included a large segment of the entire set of APES Reading participants from its inception. In addition, collecting data during the Reading allowed me to use the real-time perspectives of the Readers as they were immersed in the process. To obtain richness and depth of responses, Readers were given the entire duration of the Reading experience to respond to the survey and were given every evening as an option for their scheduled interview.

After the Reading, surveys were tabulated and interviews were transcribed. The resulting data set was then reviewed and examined to identify patterns and emerging codes and themes. Because this was an exploratory study with open-ended survey questions and semi-structured interview questions, patterns, codes, and themes were not derived in advance, but emerged during review of the data set.

Delimitations

This study focused on the APES Reading at Clemson University in June, 2004. The research was conducted to determine characteristics of the teacher Readers who participated, their view of the APES Reading as professional development, and their perceived changes in pedagogical practice resulting from participation in the Reading. The 2004 Reading was chosen in order to get a perspective from one specific group of teachers. Limiting the study to one Reading enabled me to complete the study expeditiously so that emerging results could determine the direction and scope of future studies.

All of the data were collected on-site during the Reading process itself in order to remove the influence of factors that may have affected Reader responses if these responses were obtained before or after the Reading experience. Studying participants

while they were immersed in the Reading also allowed them to directly focus on their perceptions of the Reading and its impacts on them without distractions that might interfere if they were surveyed or interviewed at other times.

Limitations

This exploratory study involved a limited number of participants and limited sampling techniques. The potential group to be surveyed and interviewed was determined by those the College Board selected as APES exam Readers and ultimately by those who chose to participate. The number of interviews conducted was dictated by the time available to Readers after they finished reading exams each day. The study focused on teachers of environmental science at the high school level. Because it was limited by the particular group that chose to participate in the 2004 APES Reading, it may not be representative of all groups that have participated in the APES Reading during the previous 6 years or those who will participate in the years that follow. Because of the participant selection process, this study sample may not be a balanced representation of characteristics of the high school teaching populace. Thus, because of the small sample size, limited scope, and nonrandom selection of participants, the results of this study are not generalizable to a larger teaching population such as all AP teachers, all secondary teachers, or all secondary science teachers.

The study was also limited by the types of data-collection instruments used. Because no appropriate existing survey or interview instruments could be found that directly addressed this study's research questions, new survey and interview instruments were developed specifically for this study. These researcher-designed instruments may have design flaws not recognized by the researcher or educational professionals who reviewed the instruments. The interviews were all conducted by the same researcher, and

thus were limited by the interview skills and perspectives of the interviewer. In spite of member checks, external audits, and other efforts to increase study validity, the analysis and synthesis of study results may also be limited by the expertise of the researcher.

Summary of Chapters

This chapter described a brief history of the Advanced Placement program, the purpose of the study, research questions, rationale for the study, an overview of study methods, and delimitations and limitations of the study. Chapter 2 provides a synthesis of relevant literature on general teacher characteristics, effective teacher characteristics, effective science teacher characteristics, effective Advanced Placement teacher characteristics, and characteristics of effective professional development. Chapter 3 describes the theoretical perspective for the study and provides a description of the study design, including study setting, study sample, data sources, instrument design, data collection techniques, subjectivity, and trustworthiness. Chapter 4 presents the results of Research Question 1 while Chapter 5 summarizes the results of Research Question 2, and Chapter 6 summarizes the results of Research Question 3. Chapter 7 discusses all of the study results and presents overall conclusions and implications of the study. This last chapter also suggests recommended changes in the APES Reading experience and proposes ideas for future studies that could expand on the findings of this study.

CHAPTER 2 LITERATURE REVIEW

To address the research questions in this study, a review of literature was conducted in the following areas: general teacher characteristics, effective teacher characteristics, effective science teacher characteristics, effective Advanced Placement (AP) teacher characteristics, and characteristics of effective professional development. Knowledge of general teacher characteristics and effective teacher characteristics guided the study design by helping me identify which characteristics of teachers to include in the survey. In addition, because the APES Reading teacher participants are Advanced Placement teachers and science teachers, literature regarding the characteristics of effective AP and other accelerated teachers and science teachers was also reviewed.

To assess the potential of the APES Reading experience as a professional development activity, I reviewed current research literature highlighting important characteristics of effective professional development. Inherent in the idea of effective professional development is the underlying concept of improving a teacher's ability to teach. Hence, this review of literature regarding effective professional development also addressed components of professional development activities that help participants become more effective teachers.

General Teacher Characteristics

When possible, this review of literature regarding general teacher characteristics focused on secondary teachers because APES Reading teacher participants are secondary

teachers. This review focused on demographic characteristics, education level, and personality characteristics of teachers.

Demographic Characteristics/Education Level

According to the Digest of Education Statistics (2002), slightly more secondary teachers in the United States are women (55%). Almost half of all United States secondary teachers have a bachelor's (48.4%) as their highest degree and slightly fewer have a master's (45.4%) as their highest degree. Most United States secondary teachers' degrees (53.5%) are in education. Table 1 summarizes the general statistics of American secondary teachers.

Table 1.1 General Statistics of Secondary Teachers

Gender	
Male	45.0%
Female	55.0%
Age (Years)	
Under 30	16.0%
30-39	21.6%
40-49	30.6%
50 and over	31.7%
Highest College Degree	
Less than a Bachelor's	1.7%
Bachelor's	48.4%
Master's	45.4%
Education specialist	3.2%
Doctorate or professional	1.3%
Undergraduate Field of Study for Secondary Science Teachers	
Education	53.5%
Science	8.1%
Other	38.4%
Teaching Experience	
Less than 3 years	13.2%
3 to 9 years	28.3%
10-20 years	26.6%
Over 20 years	31.9%
Average years experience	14

*Digest of Education Statistics, 2002

Personality Characteristics

Numerous studies have identified dominant personality characteristics of United States teachers using the four dichotomous personality dimensions of the Myers-Briggs Type Indicator. These dimensions are extroversion versus introversion, intuition versus sensing, thinking versus feeling, and perception versus judging. Lawrence (1979) conducted a study of 5,366 teachers in the United States. He did not separate elementary and secondary teachers but found that teachers in general most often have the Myers-Briggs Type of Extroverted-Sensing-Feeling-Judging (ESFJ).

Several Myers-Briggs studies have been conducted with new teachers. Hinton and Stockburger (1991), in their study of 122 teachers in the United States, and Marso and Pigge (1990) in their study of 153 teachers in the United States, also found that teachers are primarily Extroverted-Sensing-Feeling-Judging (ESFJ). McCutcheon, Schmidt, and Bolden (1991) conducted a study of 79 education graduates in a United States college and were among the first to separate personality trait research into elementary and secondary teachers. Elementary teachers were clearly Extroverted-Sensing-Feeling-Judging (ESFJ), but personality traits of secondary teachers were not so clearly identified by one dominant set of Myers-Briggs indicators. Sears, Kennedy, and Kay (1997) completed a study with 886 education graduates who had become teachers. They also grouped teachers by elementary and secondary categories. They found that elementary teachers tend to be Sensing-Feeling-Judging (SFJ), but a significant number of secondary teachers are Intuitive-Thinking-Judging (NTJ). The bipolar trait of introversion-extroversion did not produce clear results in their study.

Though the above studies provide a profile of the personality types of United States secondary teachers in general, none of these studies assessed the relative effectiveness of

teachers with different personality types. Sears, Kennedy, and Kay (1997) did suggest that teachers at the secondary level who are Intuitive-Thinking-Judging (NTJ) instead of Sensing-Feeling-Judging (SFJ) may be more effective leaders in the area of educational reform, but they did not provide data to substantiate this claim. They also suggested that Intuitive-Thinking-Judging (NTJ) teachers are more apt to investigate possibilities and relationships and are also more likely to easily adapt to innovation and change. Again, they did not provide evidence to support their claims.

The relationship between teacher personality type and teacher effectiveness was researched by Fisher and Kent (1998). In their study, 116 teachers took the Myers-Briggs Type Indicator and the Secondary College Classroom Environment Inventory. They determined that a teacher's personality can affect student learning outcomes as his/her personality sets the environment of the classroom. However, they did not determine which Myers-Briggs personality type was most effective.

Effective Teacher Characteristics

What does the literature say about the characteristics of effective teachers? Because of the plethora of literature available regarding effective teacher characteristics, I chose to focus on several books and reviews of literature which summarize effective teaching research and several key articles describing significant studies. Most of the literature reviewed in this section deals with kindergarten through twelfth grade teachers of all subject areas.

Clearly, certain teacher characteristics can and do make a difference in teacher effectiveness (Kauchak & Eggen, 1998; Stronge, 2002). The concept of teaching effectiveness was explained by Stronge (2002) as a multidimensional concept. In his review of literature, he determined that the primary focus when measuring teacher

effectiveness is usually student achievement or supervisor ratings. Stronge (2002) also reported that the attributes of caring, listening, understanding, knowing students as individuals, warmth, encouraging, enthusiastic, motivated, and loving are important in producing a more effective teacher.

In her review of literature, Cano (2001) indicated that years of research support the idea that effective teacher behaviors, rather than teacher personality traits or other characteristics and qualifications, are usually what is assessed when evaluating overall teacher effectiveness. These behaviors generally relate to creation of a positive classroom environment and teacher skills. The U.S. National Board for Professional Teachers (Education Review Office, 1998) reported the following characteristic of competent teachers: committed to students and their learning, know the subjects they teach and how to communicate that knowledge to students, accountable for monitoring student learning, learn from their experience, and are members of learning communities.

The following review of literature on effective teacher characteristics focuses on the following five areas: teacher personality traits, teacher creation of a positive classroom environment, teacher preparation and education, teacher experience, and teacher skills.

Teacher Personality Traits

In her review of literature on what constitutes effective teaching, Harris (1998) considered teachers' personality traits, behaviors or teaching styles, and artistry or creativity. She concluded that effective teaching requires reflection, growth, creativity, a vast repertoire of teaching styles, and continued professional development.

Charismatic and expressive instructors have been rated as highly effective in a study by Young and Shaw (1999). In their study, they used a 25-item survey instrument

with 912 students in 29 classes at a medium-sized western university. Survey results concluded that students viewed personality characteristics of teachers as predominant factors influencing their effectiveness.

In her review of literature and observations of teachers in one elementary, one middle school, and one high school classroom, Shelton (2003) concluded that emotional awareness is central to effective teaching. Teachers must be in touch with themselves and their own feelings before they are able to understand and motivate students. Her review of literature also indicated that effective teachers develop a good understanding of the characteristics of their students.

A study of 117 teachers of fifth through eleventh grade students by Rean and Baranov (1998) identified the importance of self-motivation for effective teachers in general and reported that internal motivation is greater in teachers with a higher level of pedagogical expertise. Their findings also suggested that more effective teachers have a more highly developed social-psychological level of tolerance. More effective teachers deal with the stresses of teaching better than less successful teachers.

Studies have also shown that effective teachers exhibit an increased tendency toward reflective thinking than their less effective peers. Kindsvatter, Willen, and Ishler (1996), Stronge (2002), and The Education Review Office (2001), all indicated a positive relationship between self-reflection and effective teaching. In her review of literature on teacher development from new to mature teachers, Hovsepian (1996) also found that self-reflection increased as teachers progressed toward becoming mature, more effective teachers. However, she also concluded that higher levels of self-esteem may be found in less effective teachers as well as more effective teachers.

Teacher Creation of a Positive Classroom Environment

Several studies stress the importance of the emotional environment teachers create in the classroom. Walls, Nardi, Minden, and Hoffman (2002) examined descriptions of effective and ineffective teachers written by 30 prospective, 30 novice, and 30 experienced teachers. All three teacher groups in this study wrote about the importance of the emotional environment created by teachers in the classroom. The groups also stressed the importance of teachers' skills, their attitudes toward teaching, and their motivation. The study done by Fisher and Kent (1998) with 116 college teachers in eight colleges also concluded that the classroom environment produced by a teacher influences students' perceptions of learning.

In their book, Learning and teaching: Research-based methods, Kauchak and Eggen (1998) emphasized the importance of teachers modeling enthusiasm in their teaching and the importance of enthusiasm in setting a positive classroom environment. They concluded that teacher enthusiasm when presenting material increases learning, self-confidence, and achievement in students. Stronge (2002) also reported that enthusiasm is an important quality in effective teachers. In their book, Effective teaching: Current research, Waxman and Walberg (1991) concluded that teachers who help create a warm, friendly, caring, enthusiastic learning environment were more likely to be perceived as effective teachers.

Teacher Preparation/Education

Teacher characteristics such as teacher preparation and education have also been shown to influence teacher effectiveness. A study by Okapala, Smith, Jones, and Ellis (2000) involving over 4,000 fourth graders and their teachers found that more effective mathematics teachers had master's degrees. Effective teaching in their study was

measured by the increase in student mathematics achievement. However, they did not indicate in what area these teachers had their master's degrees. A master's degree in education would suggest increased pedagogical knowledge, while a master's degree in math would suggest increased subject matter knowledge.

A review of literature by Harris (1998) and Fetler's (2001) review of two of his previous studies indicated that higher-level degrees in academic subjects and/or education areas increase teaching effectiveness. The studies conducted by Fetler in 1997 and 1999 were surveys of teachers in 795 high schools in California. His research concluded that higher levels of teacher education resulted in higher levels of student achievement in math (Fetler, 2001). Other researchers found that increased levels of teacher education are positively correlated with teaching effectiveness (Education Review Office, 1998; Garmston, 1998; Okapala, Smith, Jones, & Ellis, 2000; Stronge, 2002; Waxman & Walberg, 1991).

Teacher Experience

A research review by Varrella (2000) indicated that middle and high school teachers with 10 or more years of experience tend to be more effective teachers. In his review of his studies on mathematics teachers in 795 California high schools, Fetler (2001) also found a positive relationship between increased teacher experience and increased student achievement in mathematics. In their review of data from large-scale survey research, Rowan, Correnti, and Miller (2002) also associated increased teaching experience with increased mathematics achievement.

Research compiled by Stronge (2002) and Waxman and Walberg (1991) supports the view that increased teacher experience increases an individual teacher's success. Stronge's (2002) review of literature on effective teaching found a positive correlation

between more teaching experience and better planning skills, greater knowledge and understanding of students' learning needs, better organizational skills, and ultimately, increased student achievement. He indicated that experienced teachers understand student learning needs and interests better than their less experienced counterparts and thus have the potential to be more effective teachers. Waxman and Walberg's (1991) review of research on effective teaching concluded that teachers' experience and their understanding of student misconceptions are both critical in improving student learning and thus being more effective.

Teacher Skills

Several research studies have correlated teaching behaviors and teaching styles to effective teaching. Research indicates that expert teachers have a large repertoire of teaching skills and knowledge about when to use them (Cano, 2001; Education Review Office, 1998; Garmston, 1998; Harris, 1998; Stronge, 2002; Walls, Nardi, Minden, & Hoffman, 2002). Effective teachers are more successful in their use of classroom time, more organized, establish effective daily routines, and have successful classroom management skills (Stronge, 2002).

Doherty, Hilberg, Epaloose, and Tharp (2002) conducted studies with 24 middle and 57 elementary teachers over a 5 year period. They observed classes and rated the teachers on a scale of effective pedagogy. They then correlated teacher pedagogy ratings and student achievement. They reported that a wide variety of instructional activities are effectively used as teachers connect them to students' prior experience and knowledge.

In their review of literature on inclusion of student's with disabilities in the regular classroom, Mastropieri and Scruggs (2001) defined effective teaching skills as including

structure, clarity, repetition, careful pacing of instruction, showing enthusiasm, and increasing student engagement in learning.

Kotrlik, Harrison, and Redmann (2000) studied 1,126 secondary vocational teachers and found that increased technical competency has the potential to increase teacher effectiveness. They reported that increased proficiency using technology is essential to being an effective teacher in an increasingly technological world. In recent years, Internet-based education training and competency using educational technologies have been identified as essential to teacher effectiveness (Ma & Runyon, 2004).

Research indicates that effective teachers understand the value of using various questioning techniques, know when and how to use these techniques, and focus on higher order questions instead of factual questions (Brunkhorst, 1992; Varrella, 2000; Walls, Nardi, Minden, & Hoffman, 2002; Young & Shaw, 1999). Cano's (2001) review of literature indicated a positive relationship between increased wait time and more effective teachers. A review of literature by Herr (1992) reported that a change from a teacher-centered, lecture class atmosphere to a more student-centered, inquiry-based class atmosphere enables teachers to reach a greater number of students.

In their literature review of effective teaching, Foote, Vermette, Wisniewski, Agnello, and Pagano (2000) reported that effective teachers teach beyond the textbook, teach students where they are, connect daily activities to previous activities, clarify objectives, revise lessons as needed, involve students in active learning activities, involve students in the establishment of class rules and resulting consequences, show enthusiasm and confidence, pursue continual professional growth, act professionally in interactions with colleagues and students, and act professionally in dress and speech. They concluded

that these traits have been identified not only as significant for being an effective teacher, but also significant for being perceived as an effective teacher.

Effective Science Teacher Characteristics

This review of literature found that characteristics of effective science teachers are consistent with the characteristics of effective teachers in general. Several research studies have focused on effective science teachers in particular. Waxman and Walberg (1991) conducted 11 case studies involving 13 exemplary science teachers and seven exemplary mathematics teachers. These exemplary science and math teachers encouraged student engagement in learning activities, used a variety of instructional strategies to facilitate student learning, and produced a classroom environment perceived as favorable by their students. They did not specify how they determined that these teachers were exemplary.

Wise (1996) conducted a meta-analysis of 140 studies comparing traditional and alternative science teaching strategies. The data were obtained by studies reported in major science education journals, doctoral dissertations, and ERIC documents published between 1965 and 1985. He reported that teacher use of alternative teaching strategies was more effective than use of traditional teaching strategies in science. These alternative strategies include inquiry-oriented strategies that require students to be more engaged and active in their learning. He concluded that deeper student engagement in science results in greater student achievement. Wise (1996) also concluded that effective science teachers use a wider variety of assessment techniques than traditional science teachers.

Brunkhorst (1992) conducted a study of 21 science teachers that had been identified by the National Science Teachers Association as exemplary science teachers. Eight of the teachers were studied for one year and 13 were studied for two years. She

concluded that these teachers provided more hands-on experiences, asked questions more frequently, had a higher level of science content knowledge, communicated their love of science to their students, involved students more actively in their learning, and encouraged students in inquiry and asking questions more than science teachers surveyed in a national sample. They did not report how many science teachers were in the national sample or the grade level of those science teachers.

In their review of literature on inclusion of student's with disabilities in the regular classroom, Mastropieri and Scruggs (2001) also studied inclusive science classrooms over three years. They concluded that structure, clarity, repetition, careful pacing of instruction, showing enthusiasm, and increasing student engagement in learning were effective teaching skills essential to student achievement in science. They did not indicate how many science teachers or schools they studied during the three years.

Stronge (2002) cited studies linking improved student science achievement and increased teacher education levels in both science content courses and education courses. Stronge (2002) also reported that effective science teachers engage students in experimentation and discussion. The studies by Brunkhorst (1992), Stronge (2002), Waxman and Walberg (1991), and Wise (1996) all support the idea that the characteristics of effective science teachers are consistent with the characteristics of effective teachers in general.

Effective Advanced Placement Teacher Characteristics

The literature reviewed on effective Advanced Placement teacher characteristics produced inconclusive results. Accelerated learning programs include gifted, honors, pre-Advanced Placement, Advanced Placement (AP), and International Baccalaureate (IB) programs. How do teachers in these programs compare to the general teaching populace?

In their study of 12 teachers of gifted English students, Kitano and Pedersen (2002) found that the strategies and practices of gifted teachers were commensurate with strategies and practices of English teachers in general. They did not delineate what those strategies and practices were.

A regional study of gifted kindergarten through ninth grade teachers was done by Bain, Bourgeois, and Pappas (2003). The number of teachers studied ranged from 6 to 26 in each grade level. Their data came from regional, national, and state surveys completed by gifted and talented students. Their research indicated that teachers of gifted and talented students need to give more attention to building critical thinking skills in their students and need to conduct more interventions with students than they do presently.

Henderson, Winitzky, and Kauchak (1996) conducted a case study of four Advanced Placement American History teachers and their classrooms. The four teachers were classified as effective or ineffective based on their students' performance on the AP History exam. In this study, two of the teachers were identified as effective and two were identified as ineffective. This study determined that amount of instructional time, student engagement in learning, amount of homework with feedback, and number, type, and distribution of questions were key characteristics related to teacher effectiveness in AP classes. The results of this study are consistent with other studies which found that frequent questioning, high levels of student participation and engagement, and frequent assignments and tests are associated with more effective teachers (Doherty, Hilberg, Epaloose, & Tharp, 2002; Stronge, 2002; Walls, Nardi, Minden, & Hoffman, 2002).

Herr (1992) administered questionnaires to 847 AP teachers regarding their instructional practices in AP and honors classes. He concluded that teachers in AP

science classes provide a broader curriculum than teachers in regular or honors science classes. However, he reported that AP teachers are able to cover a broader curriculum because they spend more time on lecture and less time on activities that engage students in their learning.

In her review of literature about the AP program, Santoli (2002) found that most AP students believe they have the most effective teachers at their schools and indicate that having effective teachers is an important factor influencing their enrollment in AP classes. Santoli (2002) cited a study done by the National Center for History (Thomas, 1991) indicating that more AP history teachers have majors in history and more also have master's degrees than teachers in regular history classes. AP teachers in this study were also found to be more prepared, more enthusiastic, and reported spending more time in preparation than their counterparts in regular history classes (Santoli, 2002).

In contrast to Santoli's (2002) findings, a review of literature regarding AP programs by Klopfenstein (2003) found that 24% of AP teachers do not have a college major or minor in the AP subject they are teaching. This statistic is similar to the proportion of secondary teachers across all subject areas (23%) who do not have a major or minor in the field in which they are currently teaching (Stronge, 2002). These findings may be part of the impetus behind a recent decision by a school district in North Carolina to increase preparation requirements of their AP teachers. Grier's (2002) study reported that in this North Carolina school district, their three-year goal is that at least one-half of those teaching AP classes hold master's degrees, all teachers complete College Board AP training before teaching AP, and all AP teachers repeat the College Board training every

three years. All of these requirements represent the district's effort to increase the education level of their AP teachers.

Studies on effective teaching in general have indicated the importance of using a variety of teaching techniques (Cano, 2001; Doherty, Hilberg, Epaloose, & Tharp, 2002; Education Review Office, 1998; Garmston, 1998; Harris, 1998; Stronge, 2002; Walls, Nardi, Minden, & Hoffman, 2002). Two studies on the actual techniques used by teachers of accelerated students produced interesting results. In a study comparing AP and Honors classes, Herr (1992) found that the majority of AP teachers adopted a strong lecture format and minimized student-centered activities and other instructional techniques in order to move through required material more quickly. They allocated time for laboratory activities only when those activities were mandated by the program and assessed on the national AP exam.

Smerdon, Burkam, and Lee (1999) used data from the National Education Longitudinal Study of 1988 in their research. They focused their research on the portion of the National Education Longitudinal Study of 1988 that surveyed 3,660 tenth grade science students about the instructional strategies used by teachers in their science classes. They reported that high school science teachers use constructivist methods more in lower level science classes than they do in advanced classes. As with Herr's study (1992), advanced students surveyed in the National Education Longitudinal Study reported their teachers use a more teacher-centered pedagogy. A notable exception was teachers of accelerated sophomore chemistry students. Those teachers used more student-centered, constructivist activities than traditional lecture methods.

Characteristics of Effective Professional Development

Professional development is one of many terms used to describe training after teachers are employed. Though professional development occurs in different contexts, the common principle is change of educational practice (Pedretti, Mayer-Smith, & Woodrow, 1999). Literally thousands of articles have been written about professional development in the last few years alone. This makes a review of all the literature in this area virtually impossible. In an effort to summarize the major research findings related to professional development, this review of literature includes the reported findings of several reviews of literature and several significant individual studies.

The National Center for Education Statistics (NCES, 2001) surveyed 4,128 teachers (1,313 secondary teachers) regarding their perceptions of teacher preparation and professional development. These teachers cited formal professional development activities and collaboration with other teachers as the most important professional development experiences. In his review of literature, Stronge (2002) concluded that quality professional development activities are essential for producing more effective teachers and must be an ongoing, deliberate process. In his observation of 150 AP teachers attending a consortium retreat, Boyle (2003) concluded that professional development activities are important in the rejuvenation of Advanced Placement teachers. In their book, Dynamics of effective teaching, Kindsvatter, Willen, and Ishler (1996) concluded that high-quality professional development activities are essential to effective teaching and it is imperative that teachers continue to update their teaching skills.

In a survey of 450 schools, Zimmerman and May (2003) found that time constraints are the major barrier to effective professional development. This time problem involves the necessary release time for teachers to participate and the necessary time for

reflection on the activity and its implications for teaching after returning to the classroom. The National Center for Education Statistics (NCES, 2001) also reported lack of time as a major factor limiting teacher participation in professional development activities.

The following review of literature on professional development addresses characteristics of effective professional development and the influence of professional development on teaching and student achievement. This review found that the major components of effective professional development included the following: active engagement by participants, collaboration through mentoring and teacher networks, field-based experiences, increased content knowledge and pedagogy, increased time in professional development, and relevance of the professional development activity to classroom teaching.

Active Engagement by Participants

In her review of literature on professional development, Darling-Hammond (1996) reported that teachers are like students when it comes to learning. The most effective learning occurs as they are engaged in the process. In their study of over 1,000 teachers who participated in professional development, Birman, Desimone, and Porter (2000) found that active involvement by participants resulted in a more successful professional development experience for teachers. In their survey study of 39 teachers who participated in a two-day or two-week professional development institute, Shepardson, Harbor, Cooper, and McDonald (2002) attributed part of the success of a professional development activity to teacher engagement and involvement in the design of the activity. A study done by Garet (2001) on effective professional development involved 1,027 mathematics and science teachers. The results of this study indicated that effective

professional development provides opportunities for teachers to be actively engaged in the learning and planning process.

In her review of literature on professional development and adult learning, Terehoff (2002) stressed the importance of designing professional development activities based on the characteristics of adult learning as opposed to student learning. She concluded that effective professional development for adults must engage them by utilizing their experience and involving them in the design, planning, and evaluation of the activity.

In their longitudinal study of 207 mathematics and science teachers, Desimone, Porter, Garet, Yoon, and Birman (2002) found that professional development involving active learning opportunities, such as reviewing student work and obtaining feedback on teaching, increased the effectiveness of teachers' instruction. A study of over 200 teachers from five different states (Desimone, Porter, Garet, Yoon, & Birman, 2002) found that active participation in learning activities is crucial to effective professional development. The findings of this study are comparable with those of Birman, Desimone, and Porter (2000), Darling-Hammond and McLaughlin (1995), and Shepardson, Harbor, Cooper, and McDonald (2002) whose research indicated that effective professional development engages teachers through inquiry, observation, participation, and reflection.

Collaboration through Mentoring and Teacher Networks

The National Center for Education Statistics (NCES, 2001) reported that teacher collaboration revolves around mentoring and teacher networks. Mentoring is a process where veteran teachers observe, instruct, and provide feedback and reflective practice to novice teachers (Davies, Brady, & Rodger, 1999; Moir & Bloom, 2003). Networks occur when teachers develop communication with teachers in other schools or geographical

areas. These networks may be subject-area specific or focus on specific pedagogical skills (Morris, Chrispeels, & Burke, 2003; Pennell & Firestone, 1996).

The National Center for Education Statistics (NCES, 2001) reported that in the year 2000, 71% of teachers reported collaboration through mentoring with other teachers within their schools and 60% reported collaboration through external networks with teachers outside their schools. In this same report, 25% of the teachers surveyed reported mentoring another teacher in a formal relationship. Teachers also reported a positive correlation between increased collaborative activity and improved teaching.

Other studies (Davies, Brady, Rodger, & Wall, 1999; Denmark & Podsen, 2000; Stronge, 2002) have also concluded that mentoring is an effective professional development tool. In their study surveying 19 mentor teachers, Davies, Brady, Rodger and Wall (1999) reported that reflection may be the most beneficial part of the mentoring process. They found that the longer a teacher is involved as a mentor, the greater benefit they report in respect to improved teaching skills.

In an effort to improve the teaching skills of new teachers and encourage veteran teachers, a large school district in Maryland researched the effectiveness of mentoring on their teachers. They used data from 42 full-time mentors and 33 part-time mentors over a five-year period. The results led them to design, and then refine, a mentoring program for their district. Each mentor worked with 15 new teachers, analyzed journals kept by new teachers, and met with new teachers weekly. The original purpose of the program was to reduce new teacher attrition, but no statistics were supplied about success or failure in that area (Kellaher & Maher, 2003).

In their study of a mentoring project in California involving 90 mentor teachers over 15 years, Moir and Bloom (2003) also reported on the effectiveness of mentoring as a professional development activity and concluded mentoring results in increased teacher effectiveness. Birman, Desimone, and Porter (2000) surveyed more than 1,000 teachers who participated in professional development. They concluded that mentoring is a more beneficial type of professional development than more traditional workshops. They also concluded mentoring was more influential in increasing teacher effectiveness than other types of professional development. Blackwell (2004) evaluated nine teacher professional development projects in nine different states and found mentoring is an effective professional development activity for teachers.

Studies by Morris, Chrispeels, and Burke (2003) and Pennell and Firestone (1996) investigated the idea of teacher networks and professional development. Morris, Chrispeels, and Burke (2003) reviewed network programs at sites in California involving an unspecified number of teachers. Pennell and Firestone (1996) developed multiple case studies of networking teachers, principals, and regional directors in California and Vermont. Both studies indicated that content-based external networks are important in effective professional development, especially when participants stay in touch with each other after returning to their classrooms.

In her study of 93 secondary teachers and nine administrators, Lester (2003) also reported that ongoing collaboration through teacher networks was critical in teachers implementing learning after returning from a professional development activity. Teacher collaboration provided support and accountability for teachers and had a positive impact on student learning.

Technology Enhanced Secondary Science Instruction (TESSI) was a collaborative effort to increase science instruction through technology. In their evaluation of the TESSI program, Pedretti, Mayer-Smith, and Woodrow (1999), found collaboration among teachers to be an important component in professional development. Desimone, Porter, Garet, Yoon, and Birman (2002) also found that more changes in teacher instructional practice were seen with collaboration of teachers.

In her review of environmental education in the United States, Wade (1999) concluded that effective professional development must include collaborative activities among teachers. Kimmel, Deek, and Farrell (1999) also found collaboration among teachers was an important component in effective professional development.

Field-based Experiences

The term field-based professional development is used here to refer to professional development that occurs in more nontraditional settings than the traditional workshop where participants sit in a classroom and are given information from a workshop leader. Field-based experiences include professional development that occurs as teachers participate in environmental science research projects and professional development where teachers are given opportunities to immediately implement pedagogical techniques in a classroom and receive feedback from other teachers.

The importance of including field-based professional development experiences that occur in outside environmental settings was highlighted in a study done by Shepardson, Harbor, Cooper, and McDonald (2002). They used a questionnaire to study 39 teachers who participated in a two-day or two-week professional development institute. They investigated teachers' understandings of various science concepts after participation in a field-based professional development experience. They reported a substantial increase in

environmental science knowledge and a better understanding of the science concepts involved in the learning activities.

Pedretti, Mayer-Smith, and Woodrow (1999) found that professional development situated in the teachers' own classroom was perceived as an effective professional development activity and suggested this type of professional development might act as a model for other professional development activities.

Kimmel, Deek, and Farrell (1999) evaluated a model of professional development aimed at increasing knowledge and skills of science and mathematics teachers. This model was implemented in self-contained general education classrooms and included 84 participants from elementary and middle schools in New Jersey and New York. The summer practicum provided teachers with the opportunity to immediately field test curriculum and pedagogical techniques. This field-based program resulted in improved teacher effectiveness and increases in students' science and mathematics performance in the classroom.

Cardellichio (1997) evaluated three lab school sessions in Bell Middle School in Chappaqua, New York as a new model for teacher professional development. He concluded the lab school was an effective professional development activity because it resulted in increased teachers' content knowledge, curriculum knowledge, and pedagogical skills. In his review of literature on effective teacher characteristics, Stronge (2002) reported that nontraditional methods tailored to the needs of the individual are the most effective professional development activities.

Focus on Increasing Content Knowledge and Pedagogy

Guskey (2003) analyzed 13 lists of effective professional development characteristics and concluded the characteristics influencing the effectiveness of

professional development are too complex to produce definitive results regarding effective professional development. He stated that the most frequently cited characteristic of effective professional development is an activity that increases teachers' content and pedagogical knowledge. Research citing this characteristic is predominantly in science and math and might not produce definite, generalizable results in other content areas.

A study by Garet (2001) and a study by Birman, Desimone, and Porter (2000) indicated that effective professional development focuses on increasing teachers' content knowledge. Birman, Desimone, and Porter (2000) also concluded teachers experience more success when they participate in professional development activities with teachers from the same subject area. One possible reason given for this result is that a subject area connection provides opportunities for discussion of content areas, curriculum issues, and student misconceptions.

In their evaluation of a mentoring program, Moir and Bloom (2003) also reported increased pedagogical skills as an important aspect of effective professional development. In their study of mathematics and science teachers, Desimone, Porter, Garet, Yoon, and Birman (2002) found that professional development focusing on specific instructional practices increased the use of those instructional practices in participants' classrooms and broadened teachers' pedagogical practices.

Increased Time Spent on the Professional Development Activity

The National Center for Education Statistics (NCES, 2001) reported that the number of hours teachers spent in a particular professional development activity was positively correlated to their perception of improved teaching in that area. Birman, Desimone, and Porter (2000) also found the length of the professional development activity is crucial to its effectiveness. They reported that less traditional methods of

professional development experience more success because of increased time involvement.

Relevance of Professional Development Activity to Classroom Teaching

Effective professional development occurs when the professional development activity is seen as connected to the teachers' work in their own classrooms. Usefulness in teaching is an important component of effective professional development (Garet, 2001; Sparks, 1997, Stronge, 2002).

The study done by Lester (2003) concluded that activities viewed as useful to teachers as they returned to their classrooms were considered to be the most effective professional development activities. She also concluded that activities perceived as most useful were the ones most implemented by teachers upon their return to their teaching. In her review of literature on professional development, Terehoff ((2002) also concluded effective professional development for adults centered on activities teachers might use in their classrooms.

Relevance of Professional Development Activity to Teaching and Student Achievement

Huffman, Thomas, and Lawrenz (2003) conducted a study involving 94 science teachers and 104 mathematics teachers for the purpose of determining the relationship between different types of professional development, teacher instructional practices, and student achievement in science and math. Professional development of individual teachers was not reported to be effective in changing teacher practices. They also reported a weak relationship between teacher participation in professional development and student achievement on state exams in these areas.

The National Science Foundation's Urban Systemic Initiatives (USI) program is an extensive national strategy to improve math and science literacy of all students and prepare them for employment in a knowledge-based economy. In her review of the USI, Long (1996) concluded that for professional development to be successful it must not just target individual teachers. Effective professional development must be systemic and seek reform of the entire school system. The reform must include curriculum and instruction, assessment, management, finance, school policy, and community and business relationships.

Desimone, Porter, Garet, Yoon, and Birman (2002) concluded that high-quality professional development increases teacher effectiveness, but most teachers do not experience high-quality professional development. Pennell and Firestone (1996) used multiple case studies in their research on the effect of teacher beliefs, background experiences, and social and professional experiences on professional development. Their results were inconclusive, but they reported that professional development resulting in teacher change is not as successful with older, more experienced teachers.

Summary of Review of Literature

The majority of secondary teachers are female (55%) and have bachelor's degrees (48.4%) or master's degrees (45.4%) as their highest level of education (Digest of Education Statistics, 2002). Teachers in general exhibit Extroverted-Sensing-Feeling-Judging (ESFJ) personality traits as measured on the Myers Briggs Type Indicator (Hinton & Stockburger, 1991; Lawrence, 1979; Marso & Pigge, 1990).

Teachers' personality traits are an important factor in setting a positive classroom environment (Fisher & Kent, 1998; Stronge, 2002; Walls, Nardi, Minden, & Hoffman, 2002). Specific personality traits contributing to effective teaching are reported as

expressive (Young & Shaw, 1999), self-motivated and high level of tolerance of stress (Rean & Baranov, 1998), high levels of self-reflection (Hovsepian, 1996; Kindsvatter, Willen, & Ishler, 1996; Stronge, 2002; The Education Review Office, 1998), and enthusiasm (Foote, Vermette, Wisniewski, Angell, & Pagano, 2000; Kauchak & Eggen, 1998; Stronge, 2002; Waxman & Walberg, 1991).

Several additional factors characterize effective teachers:

- Higher levels of teacher preparation and education (Education Review Office, 1998; Fetler, 2001; Harris, 1998; Okapala, Smith, Jones, and Ellis, 2000; Stronge, 2002; Waxman & Walberg, 1991).
- Increased student engagement in learning (Brunkhorst, 1992; Cano, 2001; Foote, Vermette, Wisniewski, Agnello, & Pagano, 2000; Henderson, Winitzky, & Kauchak, 1996; Herr, 1992; Varrella, 2000; Walls, Nardi, Minden, & Hoffman, 2002; Young & Shaw, 1999).
- Increased teacher experience (Education Review Office, 1998; Fetler, 2001; Grissmer & Kirby, 1998; Rowan, Correnti, & Miller, 2002; Stronge, 2002; Varrella, 2000).
- Understanding and use of questioning skills (Brunkhorst, 1992; Cano, 2001; Varrella, 2000; Herr, 1992; Walls, Nardi, Minden, & Hoffman, 2002; Young & Shaw, 1999)
- Use of a wide variety of instructional skills (Cano, 2001; Doherty, Hilberg, Epaloose, & Tharp, 2002; Education Review Office, 1998; Harris, 1998; Stronge, 2002; Walls, Nardi, Minden, & Hoffman, 2002).

Characteristics of effective science teachers are consistent with the characteristics of effective teachers in general (Brunkhorst, 1992; Stronge, 2002; Waxman and Walberg, 1991; Wise, 1996). Several studies reported the importance of inquiry-based teaching for effective science teaching (Brunkhorst, 1992; Stronge, 2002; Wise, 1996)

Studies of effective accelerated or AP teachers are more inconclusive. Several studies concluded that characteristics of effective AP teachers are consistent with the characteristics of effective teachers in general (Henderson, Winitzky, & Kauchak, 1996;

Kitano & Pedersen, 2002). Other studies indicated that AP teachers use lecture more than other teachers, but did not specify if these are effective AP teachers (Herr, 1992; Smerdon, Burkam, & Lee, 1999).

Key characteristics of effective professional development were reported in the literature.

- Active engagement by participants (Birman, Desimone, & Porter, 2000; Darling-Hammond, 1996; Darling-Hammond & McLaughlin, 1995; Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, 2001; Shepardson, Harbor, Cooper, & McDonald, 2002; Terehoff, 2002)
- Collaboration through mentoring and teacher networks (Birman, Desimone, & Porter, 2000; Blackwell, 2004; Davies, Brady, Rodger, & Wall, 1999; Denmark & Podsen, 2000; Desimone, Porter, Garet, Yoon, & Birman, 2002; Kellaher & Mayor, 2003; Kimmel, Deek, & Farrell, 1999; Lester, 2003; Moir & Bloom, 2003; Morris, Chrispeels, & Burke, 2003; National Center for Education Statistics, 2001; Pedretti, Mayer-Smith, & Woodrow, 1999; Pennell & Firestone, 1996; Stronge, 2002; Wade, 1999).
- Field-based experiences (Cardellichio, 1997; Kimmel, Deek, & Farrell, 1999; Pedretti, Mayer-Smith, & Woodrow, 1999; Shepardson, Harbor, Cooper, & McDonald, 2002; Stronge, 2002).
- Focus on increasing content knowledge and pedagogy (Birman, Desimone, & Porter, 2000; Desimone, Porter, Garet, Yoon, and Birman, 2002; Garet, 2001; Guskey, 2003; Moir & Bloom, 2003)
- Increased time spent on the professional development activity (Birman, Desimone, & Porter, 2000; National Center for Education Statistics, 2001).
- Relevance of professional development activity to classroom teaching (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, 2001; Lester, 2003; Stronge, 2002)

Research on the impact of professional development on teaching practice is inconclusive (Guskey, 2003; Pennell & Firestone, 1996). Several studies found a positive correlation between participation in professional development and increased student achievement (Desimone, Porter, Garet, Yoon, & Birman, 2002; Lester, 2003), while other studies found no such correlation (Huffman, Thomas, & Lawrenz, 2003)

CHAPTER 3 METHODOLOGY

This study was designed to answer the following research questions.

- Research Question 1: What are the characteristics of teacher participants at the APES Reading and what are the characteristics of veteran teacher participants who view the APES Reading as a positive professional development experience?
- Research Question 2: For veteran teacher participants who view the Reading as a positive professional development experience, what aspects of the Reading do they perceive are most beneficial to them?
- Research Question 3: For veteran teacher participants who view the Reading as a positive professional development experience, how do they report their professional practice has changed as a result of participation in the Reading?

This chapter describes the theoretical perspective that guided the research and summarizes key aspects of the study design.

Theoretical Perspective

This study is written from a constructivist paradigm. This paradigm believes multiple realities exist and are constructed from individual perspectives and the unique experiences of those individuals. In this paradigm, the researcher and participants are in the process of coconstructing reality (Hatch, 2002). As Moustakas (1994, p. 27) stated,

The challenge facing the human science researcher is to describe things in themselves, to permit what is before one to enter consciousness and be understood in its meanings and essences in the light of intuition and self-reflection. The process involves a blending of what is really present with what is imagined as present from the vantage point of possible meanings; thus a unity of the real and the ideal.

Qualitative Research

The methodology used to pursue this constructivist theoretical perspective is qualitative research. Qualitative or naturalistic research is a general term that includes a number of fields such as ethnography, case study, phenomenology, and hermeneutics (Glesne, 1999; Schwandt, 1997). An important aspect of qualitative research is that it builds inductively instead of testing concepts, hypotheses, and theories (Goetz & LeCompte, 1984; Merriam, 1998).

In their listing of characteristics of naturalistic or qualitative research, Lincoln and Guba (1985) identified several factors that helped guide the design of this study. In their opinion, the qualitative researcher sees reality in wholes and does not think that reality can be divorced from the context in which it takes place because there are multiple constructed realities and they must be studied holistically. Qualitative research also views the researcher as the primary data-gathering instrument. This type of research recognizes that the researcher is essential to the identification of biases and acknowledges that the researcher and respondents have mutually shaping effects on each other. Qualitative research allows the negotiation of meanings and interpretations because of the human sources from which the data are drawn. This type of research is hesitant to make broad generalizations of findings because of the particular settings and interactions in which data are gathered (Patton, 1985).

All of these characteristics were part of the rationale for selecting the qualitative research methods used in this study. This exploratory study was done on-site to ensure the participants were not divorced from the setting. The study sought to look at a specific situation and the interactions within that situation. It was not an attempt to test pre-

existing theories or ideas, but was an endeavor to understand certain aspects of one case study, the APES Reading.

Case Studies as Qualitative Research

Qualitative case studies are prevalent in education research. Merriam (1998) indicated that the purpose of some qualitative studies in education is to understand and discover processes and entities or the views of people involved in those processes and entities. A case is chosen because of particular concern about the case and the desire to uncover various factors that characterize the case. In a case study, the researcher is interested in gaining insight, understanding, and interpretation and not in hypothesis testing. The focus is on a holistic description and explanation. It is impossible to separate the variables within the case from their context. The researcher gets as close to the subject as possible by observing the case in the natural setting in which it occurs (Yin, 1994).

The most defining characteristic of a case study is that it is a bounded system. It is a single entity, phenomenon, event, program, or social unit around which there are clear boundaries (Shaw, 1978; Smith, 1978). To be considered a case study, the entity to be studied must have finite data collection opportunities, a limited number of people, and a definite time period (Merriam, 1998).

The methods of data collection in a case study are varied. They range from testing to interviewing and the case study design is particularly helpful in answering “how” and “why” questions. The case study design is also helpful if the focus of the research is on the process. The idea of process includes describing the context, describing the population of the study, and explaining or discovering what occurred as a result of the process.

Case studies may be descriptive, interpretive, or evaluative. The descriptive case study gives a detailed account of the entity being studied and the interpretive case study gathers information about the entity for the purpose of analyzing or theorizing about the case. An evaluative case study provides a holistic description, communicates and interprets findings, and uses the information gained to produce judgments (Merriam, 1998).

The particular case investigated in this study was the APES Reading. It was chosen because I was interested in better understanding the entity, its participants, and its possible impacts on teachers and education. The APES Reading is a bounded system because it occurs in a clearly defined time and has a set number of possible participants. A limited number of data collection points were created by narrowing the focus of the study to three basic research questions.

The study was descriptive as I focused on the essence, structure, and characteristics that are a part of the APES Reading experience. During the study, I also explored the characteristics of teachers who participated in the Reading experience. This study was interpretive as I sought to understand the perceived value of the Reading experience to teacher participants, examined how they viewed the consciousness they achieved through self-reflection, and saw how this enhanced consciousness influenced their teaching practices. The study was also evaluative as I sought to determine if the APES Reading was perceived as having professional benefits to the participants, influenced them to change teaching practices, and might serve as an effective professional development activity. Therefore, this particular case study would be defined as evaluative.

Study Design

The design chosen for this study was based on my understanding of qualitative research and case study design and the conviction that these provided the best approach to exploring the proposed research questions. This section includes information regarding the study setting (the APES Reading experience), study sample, study design, data sources, instrument design, data collection techniques, data analysis techniques, subjectivity, and trustworthiness.

Study Setting: The APES Reading Experience

The Advanced Placement Environmental Science (APES) Reading is organized for the purpose of grading the free-response portion of the national APES exam. The Reading was held on the campus of Clemson University in Clemson, South Carolina and lasted for a period of seven days. This section describes the APES exam organization, identifies roles and selection criteria for Reading participants, and discusses the exam setting, pre-Reading rubric development process, exam Reading process, and evening activities.

Exam organization. During the national APES exam, students are allotted 90 minutes to complete 100 multiple choice questions about various environmental science topics. These multiple choice questions constitute 60% of their final APES exam grade. Students are also allotted 90 minutes to complete the essay portion of the exam. The free-response portion is composed of four free-response questions valued at 10 points each and comprises the remaining 40% of their final exam grade. The purpose of the free-response section is to test students' ability to apply environmental science principles in greater depth than multiple choice questions allow. One of the questions is based on a data-set and one is document-based. Two of the questions are synthesis and evaluation

type questions. The final exam score ranges from 1 (lowest) to 5 (highest). Though colleges have different criteria regarding granting AP credit, most award college credit for scores of 3 and above (AP Central, 2004; College Board, 2001).

Roles and selection criteria for Reading participants. There are four types of participants in the APES Reading. These include the Chief Reader, Question Leaders, Table Leaders, and Readers. The Chief Reader has the overall responsibility of guiding and supervising the grading of the APES exam. This person works directly with four Question Leaders who each supervise the grading of one of the four free-response questions on the exam. Each of the Question Leaders is responsible for two or more Table Leaders. The Table Leaders supervise and guide a group of 25 to 30 exam Readers.

The Chief Reader is a college or university science faculty member and must have several years of previous experience as an AP Reading participant. It is also desirable for the Chief Reader to have prior experience as a Table Leader and/or Question Leader (Postawko, S. email on APES Reading received 8/6/04). The Chief Reader must have strong organizational, writing, and management skills. Each year, the Chief Reader is chosen by College Board personnel responsible for handling the APES course.

Question Leaders are chosen based on past Table Leader or Question Leader experience at previous Readings and on the recommendation of current Table Leaders and Question Leaders. A particular Question Leader directs all of the Table Leaders for a given question. Question Leaders must be able to communicate in a clear and concise manner, use discretion when working with others, have the ability to resolve issues that crop up between Table Leaders and Readers, and possess good writing skills. Question Leaders spend the majority of their time writing and refining rubrics, writing commentary

for sample papers that is posted on the College Board web site, and writing commentary about their particular designated question that is included in the Chief Reader report.

When selecting Question Leaders, the College Board looks for a balance of college and high school personnel, males and females, and representatives from diverse geographic regions (Postawko, 2004).

Table Leaders are selected from a list of Readers who have had several years of prior experience at the APES Reading and are recommended by current Table Leaders and Question Leaders. The Table Leaders each guide a group of 8 to 15 Readers as they grade one of the four free-response questions. Table Leaders must be able to communicate in a clear and concise manner. They must use discretion when working with others and have the necessary confidence and skills to promote consensus within a diverse group. They also need to be able to work one-on-one with Readers who have trouble understanding the rubric or applying the rubric consistently. Among Table Leaders, an attempt is made to have equal numbers of high school and university personnel, equal numbers of males and females, and representatives from different regions of the United States (Postawko, 2004).

Readers of the national APES exam are high school teachers of AP environmental science and college professors who teach environmental science or a course containing material similar to that taught in APES. Each Reader receives an honorarium of approximately \$1500. Their travel expenses to and from the Reading and food and lodging expenses incurred during the Reading are all reimbursed. High school teachers who serve as Readers must be currently teaching APES and have taught it for at least three years (AP Central, 2004; Postawko, 2004).

Potential Readers complete an application through the College Board web page. These college and high school teachers provide information on their educational background and their teaching background. The Chief Reader reviews the applications and issues invitations to participate if they (and an established committee) think applicants are qualified in the exam area (College Board, 2001; Postawko, 2004).

Exam setting. During this study Reading participants were housed in one section of student apartments on the Clemson campus. Each had his/her own bedroom in a two-bedroom apartment, but shared a bathroom, kitchen, and living room area. Participants were allowed to select roommates, but if no selection was made, they were assigned a roommate. Meals were provided for all participants at one of the university cafeterias a short distance from the apartment area.

The 2004 APES Reading took place in a series of classrooms in one of the buildings on campus close to the cafeteria. Each of the 12 Table Leaders and corresponding group of 8 to 16 Readers had their own room. This enabled the Readers to have a quiet area for each day's Reading. They sat in chairs around large tables, with sufficient workspace for essay booklets which contained items they were scoring. They also had a copy of the rubric, pencils, and special erasers.

Readers read from 8:00 a.m. to 4:45 p.m. each day for the seven days with a 15-minute break in the morning and a 15-minute break in the afternoon. During breaks, participants went to an outside area where they were served refreshments and had an opportunity to converse with each other. They were also given an hour each day for lunch in the cafeteria. For a complete schedule of the APES Reading see Appendix C.

Pre-Reading rubric development. In the 2004 APES Reading, the Chief Reader and four Question Leaders met for three days prior to the Reading and the 12 Table Leaders met with the Chief Reader and Table Leaders for two days prior to the Reading. During these pre-Reading meetings they discussed exam grading procedures, Reader placement, and worked together to develop tentative grading rubrics for each of the four free-response exam questions. Question Leaders submitted a draft of the proposed rubric for the question they had been assigned, read exam booklets containing answers to their assigned question, and refined their rubric draft. The Chief Reader and Question Leaders reviewed each rubric for each question and made comments and suggestions for future revision.

During the process of rubric development for each free-response question, the Question Leader and his/her assigned Table Leaders worked primarily on their assigned question, but there were a number of times during the two days of rubric development when Question Leaders presented tentative rubrics to the entire group for discussion and review. During this two day period prior to the Reading, Question Leaders and Table Leaders also discussed training techniques and discussion methods to be used with the Readers and produced copies of tentative rubrics to be distributed to Readers. The philosophy of rubric development at the 2004 APES Reading was to keep the scientific integrity of the rubric and yet better distinguish among excellent, good, and average students. Papers were read with an eye toward being able to give points to students who obviously demonstrated understanding of the question topic (Postawko, 2004).

During this pre-Reading time, the Chief Reader also determined which Readers would be assigned to which free-response question. The Chief Reader assigned a mixture

of veteran teacher participants and new teacher participants to each question. Readers read the same question for the seven days unless there was a need to move them because their question was being read faster than another question.

Exam Reading process. During the 2004 APES Reading, Readers scored a total of 32,635 exams. One Question Leader and three Table Leaders were assigned to each of the four questions. The number of Readers assigned to each question varied with the question. The Chief Reader assigned more Readers to questions they felt took longer to grade due to the variability of answers, number of parts, and many other factors. Though each question began with approximately 30 Readers, the number of Readers on each question shifted during the course of the Reading as some questions read faster than others.

When the 119 Readers arrived for the 2004 APES Reading, they began with a large group meeting on Day 1. During this meeting they were given information about the Reading process and met Clemson administrators and College Board personnel. At the close of the meeting, each Reader was assigned to one of the free-response questions. They then met the Table Leader for their question and were escorted to their assigned Reading room.

Table Leaders then presented tentative rubrics to the Readers. The goal was to help Readers understand the structure and purpose of the rubric and how to apply the rubric to the question. Readers were able to provide input and suggest alterations and changes in the rubric. The group of Table Leaders and Question Leaders discussed these proposed alterations with each other and with the Chief Reader. Revised rubrics were presented to the Readers near the end of the morning, and Readers were trained in the use and

application of the rubric. All of this was done in advance to ensure consistency as the exams were graded.

By noon on Day 1, each new Reader was paired with a veteran Reader. Each member of the pair then read a set of five essays. They wrote a number from 1-10 on a post-it note to indicate the score they gave that particular essay. They exchanged the five essays with their partner and read and scored the new set of five essays. The Readers then compared their scores for each essay, discussed any discrepancies, and came to an agreement about the appropriate score for each essay. If they could not agree on a score, they asked the Table Leader to read and score the essay. Then the three of them discussed the appropriate score for the essay. This process continued until the two Readers were consistently assigning the same number of points in the same places within each essay.

After inter-rater reliability of scoring was achieved, each Reader was given a folder of 25 essays to grade independently. Readers recorded their Reader number, the question number, and the points for each essay on a scantron sheet that was turned in with each folder of 25 essays. For the first two days, the Table Leader checked the Readers by reading some of the essays in each booklet the Readers had graded. Table Leaders discussed their grading and the Reader's grading until consistent scores were achieved. This process of backreading by Table Leaders helped to ensure greater consistency in grading.

When Table Leaders were convinced that a Reader was correctly and consistently applying the rubric, they stopped reading behind that Reader and focused their attention on Readers who were having difficulty. Readers' scores were checked at the Table Leader's discretion throughout the rest of the Reading process. During the Reading,

exams were also periodically graded by two different Readers and the scores of the two Readers were compared for consistency.

In order to minimize noise and assist in the overall Reading process, aides brought new folders to Readers and picked up completed folders. The Readers raised their hands if they had a question about an essay and the Table Leader came to them to answer the question. If the question was pertinent to all Readers, the Table Leader interrupted the Readers, explained the concept or change, and went to other rooms that were reading the same question to explain the situation to that Table Leader. This process continued throughout the seven days of reading.

On the morning of Day 8, all participants attended a large group meeting where Question Leaders explained the rubric for the assigned free-response question. Each Question Leader included information on grading challenges experienced by the Readers of their question, common misconceptions of students related to their question, and common errors students made in answering their question. The Readers were informed that they graded 32,635 exams and that 50.4% of students received a score of 3 or higher on the exam. Readers were provided with the scoring statistics for each of the four free-response questions (Table 3.1) and information on check-out procedures and travel information.

Table 3.1 Free-Response Questions Scoring Statistics for the 2004 APES Exam

Question Number	Mean	Standard Deviation	Number of Possible Points
1	4.10	2.05	10
2	2.70	2.24	10
3	3.65	2.47	10
4	3.84	2.54	10

*AP Central, 2004

Evening activities. Readers were provided a commons area in the apartment complex where they enjoyed refreshments and socialization after the Reading ended each day. Though most Readers left the area by 10:00 p.m., the commons area remained open until midnight each evening. Informal interactions in the commons area provided a setting for rapport building among participants. Participants were also provided an opportunity on Day 3 to attend an environmental science Professional Night after the day's Reading. Two other evenings, they had the option to watch movies in one of the campus auditoriums. Additional optional evening activities included a trip to a local outlet mall, a college baseball game, and an AP informational event hosted by the College Board. Participants were also given access to the campus bowling alley, gymnasium, and pool.

Study Sample

The sample selected for this study was purposeful. Purposeful sampling is the intentional selection of samples in order to provide information-rich cases (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998). Because of the significant differences in general characteristics of college professors and high school teachers, the decision was made to limit the study sample to high school APES Reading teacher participants. The sample for this study consisted of the 114 high school teachers who participated as APES Readers, Table Leaders, and Question Leaders in the APES Reading held June 3-10, 2004 on the campus of Clemson University in Clemson, South Carolina. This sample was selected in an attempt to understand this particular group of APES teachers, obtain as much variety in multiple realities as possible, and yet limit the study sample to a manageable number.

One hundred nineteen Readers participated in the 2004 APES Reading. Seventeen were college or university professors and 102 were high school teachers. Twelve Table

Leaders participated in the 2004 Reading. Eight were high school teachers and four were college professors. Four Question Leaders participated in the 2004 Reading. Three of the Question Leaders were high school teachers and two were college professors.

There was also a Question Leader for alternate exams. This person was a high school teacher and eligible for participation in the study. Alternate exams are taken by students who are unable to take the exams during the scheduled exam time. These exams do not arrive until several days into the Reading. During the interim time the Question Leader for the alternate exam generates rubrics for each of the four free-response questions on the alternate exams because the alternate exams have different essay questions and must be graded by a separate group of Readers. Depending on the number of alternate exams, two to three Readers are pulled from reading other questions to join the alternate exam Question Leader who supervises the grading of the alternate exams. During the 2004 Reading, two Readers were pulled from their original questions to join the alternate exam Question Leader.

Of the 114 teachers participating in the Reading, 56 were male and 58 were female. Sixty of the 114 teacher participants completed a research survey for this study. Of these, 30 were male and 30 were female. Fifty-nine of the 60 survey respondents also volunteered to participate in semi-structured interviews. Unfortunately, there was only time to interview 18 teacher participants during the course of the Reading. Ten of the interviewees were female and eight were male.

Interview participants were selected on a first come, first served basis from those who completed a survey and indicated their willingness to be interviewed. As I became overwhelmed with interview volunteers, preference was then given to those with the

greatest amount of previous APES Reading experience. This decision was made as a result of studies that indicate increased length of service is important in increasing confidence and depth of opinions received during an interview (Lincoln & Guba, 1985).

Data Sources

The decision to collect all data during the Reading was based on recommendations of several qualitative researchers. First, qualitative researchers argue that data should be collected in the natural setting where the activity is occurring (Glesne, 1999; Lincoln & Guba, 1985, Rubin & Rubin, 2005). Conducting this study at the Reading site allowed for data collection in the natural setting of the Reading. Second, in qualitative research, researcher identification with study participants helps in the building of trust (Merriam, 1998; Rubin & Rubin, 2005). Conducting the research at the Reading site enabled the teacher participants to see me not only as a researcher, but also as a teacher and a previous Reading participant. My presence at the Reading site also allowed newer participants to observe the positive interactions between me and veteran participants that have known me for several years.

Third, in qualitative research, collecting data in the actual setting where the case is occurring allows the researcher to make informal observations of study participants and their interactions (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Rubin & Rubin, 2005). My informal observations were an important component in understanding the views of the teacher participants. Finally, in qualitative research, allowing adequate time for interviews and setting a focus on the importance of the research helps increase the level of participant involvement (Glesne, 1999; Merriam, 1998; Rubin & Rubin, 2005). In my study, scheduling interviews during the Reading experience provided a convenient time to conduct interviews with participants and provided an opportunity for me to

explain the importance of the study to all participants. Using the Reading time for data collection also allowed me to capitalize on the fact that Readers were immersed in the Reading experience and thus were more cognizant of its influence on them.

Several qualitative researchers (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Yin, 2003) stress the need for having more than one data source in qualitative research. In this study, the construction of multiple realities was pursued through two pertinent, accessible data sources: surveys and semi-structured interviews. Limited informal observations were also made of Reader interactions during the course of the Reading. The choice to use interviews and surveys was partly based on information from Glesne's (1999) and Schwandt's (1997) discussions of the value of open-ended surveys and interviews in qualitative research design. Through the use of survey responses, especially survey comments, and interviews I attempted to construct some of the multiple realities related to the APES Reading as viewed by the Reading participants.

Initial surveys of all teacher participants in the study provided a broad perspective regarding the general characteristics of APES Reading teacher participants. Answers to straightforward, direct questions regarding educational background, age, teaching experience, previous Reading experience, educational philosophy and background, preferred teaching resources and strategies, and past participation in professional development activities were easily obtained from a written survey. To provide adequate time for survey completion, participants were given the entire eight days of the Reading experience to respond if they so desired. This flexibility was yet another advantage of collecting all data on-site during the Reading.

Merriam (1998) and Lincoln and Guba (1985) indicated that interviews are usually the basic data source or part of the overall data set in all qualitative research studies. Dexter (1970) defined an interview as a “conversation with a purpose” (Dexter, 1970, p. 136) and Rubin and Rubin (2005) referred to interviews as extended conversations. Through my interview conversations with teacher participants, they were able to share their thoughts about specific aspects of the Reading and the Reading experience’s influence on their teaching practice.

According to Patton (1985), the purpose of interviews is to determine what is on the mind of another person. Interviews are essential when we cannot actually observe behavior and when we want to determine how people interpret the world around them (Merriam, 1998). Rubin and Rubin (2005) stressed the importance of self-reflection to the interviewee and the importance of the researcher hearing what the respondent is saying in their self-reflection and not what the researcher wants to hear. In this study, a conscious attempt was made to hear what the participants reported about their Reading experience and its impacts on them.

The interviews in this study allowed me to assess the views and ideas of teacher Reading participants because it was not feasible to follow-up later and actually observe changes in participants’ teaching practice. Interviews also allowed me to probe and pursue areas of conversation that could not be anticipated or determined ahead of time. Thus, in this study semi-structured interviews enabled a depth of data not possible with any other method.

Instrument Design

Items for the surveys and semi-structured interviews were designed over the course of approximately 3 months. During this time, drafts of the survey and interview questions

were reviewed by the entire doctoral committee to increase the likelihood that they would elicit adequate and pertinent information related to the research questions.

Survey. The survey was designed primarily to address Research Question 1: “What are the characteristics of teacher participants at the APES Reading and what are the characteristics of veteran teacher participants who view the APES Reading as a positive professional development experience?” The survey was composed of four parts: Motivations for Reading Attendance and Educational Philosophy/Practice, Previous APES Reading Experiences, Demographic Information/Employment History, and Professional Development Experiences. For a copy of the survey, refer to Appendix B.

Motivations for Reading Attendance and Educational Philosophy/Practice included survey items 1-11. Items 1, 2, and 11 provided participants with the opportunity to indicate and rank their motivations for attending the Reading, while items 3-4 gave participants the opportunity to identify instructional techniques they used. Items 5-6 provided participants with the opportunity to indicate which resources they used in their classrooms and items 7-8 provided the opportunity to list assessment techniques used. Items 9-10 provided the opportunity to rank their comfort level with pedagogy and environmental science knowledge.

Previous APES Reading Experiences included items 12-17 and was completed by those who had participated in previous Readings. Item 13 asked Readers to indicate the number of years they had participated in the APES Reading. Items 14 and 15 asked Readers about aspects of the Reading they found professionally rewarding. These three items addressed Research Question 2: “For veteran teacher participants who view the

Reading as positive professional development experience, what aspects of the Reading do they perceive are most beneficial to them?”

Survey item 16 asked participants to indicate if participation in the APES Reading changed their professional practice. If the answer was yes, item 17 asked them to clarify how their practice had changed. These two survey items addressed Research Question 3: “For veteran teacher participants who view the Reading as a positive professional development experience, how do they report their professional practice has changed as a result of participation in the Reading?”

Demographic Information/Employment History included items 18-27. Items 18-19 addressed participant age and gender, while college degrees earned is addressed by item 20. Items 21-22 addressed participant employment history, while items 23-27 addressed years of teaching experience, courses taught, and number of sections of APES taught. Answers to these items provided information pertinent to Research Question 1 which focused on teacher characteristics.

Professional Development Experiences included items 28-34. Items 28-29 addressed coursework that was not part of a degree program, while professional service and professional development participation was addressed in items 30-31. Professional service magazines received, membership in professional organizations, and awards received were addressed in questions 32-34. This section helped identify characteristics of teacher participants which was the focus of Research Question 1. These items were also helped clarify the views of and commitments to various types of professional development.

Items on the survey were evaluated by the doctoral committee for clarity, bias, ease of recording, flexibility, and open-endedness. Opportunities for elaboration were added to many items to allow respondents to provide information not listed in the response options provided. The order of survey items was also changed as a result of doctoral committee input to reduce or eliminate perceived value perceptions and personal biases of the researcher. The final survey consisted of 22 open-ended items, 10 table-completion items, and 2 Likert-type items for a total of 34 items.

Interviews. After reviewing the research on the development of effective interview questions (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Yin, 2003), potential interview questions were developed for this study (see Appendix C for interview protocol). These questions were designed to provide teacher Reading participants with a venue for sharing their thoughts, feelings, and views regarding their teaching philosophy and practice. They were also designed to allow teacher participants to express their thoughts about the Reading experience and its impact on their teaching practice. The interview protocol used open-ended questions that allowed teacher participants to share their thoughts instead of merely reinforcing views and perspectives of the researcher (Rubin & Rubin, 2005).

Drafts of interview questions were submitted to the doctoral committee for review. Over the course of approximately two months, changes and revisions were made to ensure that the questions were clear, concise, and as bias free as possible. The questions were arranged in an order that allowed the interviewees to begin with the least threatening questions, followed by main questions and sub-questions designed to probe and further clarify responses to the main questions (Glesne, 1999; Rubin & Rubin, 2005).

The semi-structured interview protocol was divided into three sections: About your teaching, About the APES Reading, and Impact of the APES Reading on your teaching.

The “About your teaching” section of the interview protocol included interview questions 1-6. Questions 1-5 encouraged Reading participants to talk about what they view as an effective science teacher, how close they are personally to their view of an effective science teacher, and changes they would like to make in their teaching to help them reach their vision of an effective science teacher. Question 6 gave participants the opportunity to discuss the types of assessments they used in their classroom. The interview questions in this section focused on Research Question 1 by providing a broader picture of the characteristics of some of the Reading participants.

The “About the APES Reading” section included interview questions 7-15. Questions 7 - 10 focused on Research Question 2 regarding the perceived benefits of the Reading to them. In question 7 participants were asked what kept them coming back to the Reading, while question 8 focused on why they thought teachers should participate in the Reading. Questions 9-10 asked them to tell the best and the worst thing about the APES Reading. Questions 11-15 focused on the overall question of the research study as interview participants were asked about how the Reading functions as a professional development activity.

The third section of the interview protocol, “Impact of the APES Readings on your teaching”, included questions 14-17. Questions 14-15 addressed the influence of the Reading on interview participants’ views of important environmental science concepts and teaching philosophy. Questions 16-17 addressed perceived changes in their teaching

and assessment practices as a result of participation in the Reading. These questions addressed Research Question 3 regarding perceived changes in professional practice.

Data Collection Techniques

Data collection occurred during the course of the 2004 APES Reading and began the first day of the Reading (June 3rd). The Chief Reader introduced me to the participants in their opening meeting, and I was given a brief opportunity to explain who I was, the purpose of my study, and the techniques and procedures for data collection. A cover letter (Appendix E) attached to the survey packet also outlined this information in writing. A cover letter explaining who the researcher is, the purpose of the study, and potential use of the study has been reported to be important for obtaining a higher response rate from potential participants (Rubin & Rubin, 2005).

Surveys were handed to everyone on Day 1 as they left the opening meeting. They were instructed to return the surveys by Day 7. Completed surveys were placed in a box in the hallway where participants were reading or given to me personally as participants saw me through the course of the APES Reading. Because I had no access to conference rooms or classrooms on campus, interviews were conducted in a rental apartment on campus. This location made it easy for volunteers to meet with me and provided the privacy needed for the interviews. The interviews were originally scheduled for 45 minutes, but I clarified with interviewees that the actual length of the interview was based on their desire to share information with me. The interviewees were given the questions ahead of time to allow for deeper thought, more self-reflection, and clearer organization of thoughts.

Interviews began on the evening of Day 1 and continued each evening through Day 7. All interviews were audiotaped and interviewees were asked to answer only those

questions that they felt comfortable answering. They were asked to turn off the tape if they became uncomfortable or wanted to terminate the interview. During the interviews, I endeavored to keep on topic and still probe for depth, detail, clarity, and understanding (Glesne, 1999; Lincoln & Guba, 1985; Rubin & Rubin, 2005). Efforts were made to truly hear what the interviewees were saying and not what I as a researcher wanted to hear (Rubin & Rubin, 2005). Although interviews were originally scheduled for 45 minutes, most lasted approximately one hour and a few went over an hour. In accordance with previous research on interview volunteers (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Rubin & Rubin, 2005), most interviewees indicated that my relationship with them as result of participation in previous Readings encouraged them to volunteer to be interviewed. They also cited interest in the information being collected as a contributing factor in their willingness to be interviewed.

Data Analysis Techniques

“Analysis is a search for *patterns*” (Spradley, 1980, p. 85). Glesne (1999), Merriam (1998), Lincoln and Guba (1985), Wolcott (1994), and Yin (2003) all attest to this need for discovering patterns in the data collected in qualitative research. Data analysis leads to reconstruction of data and not just recording of that data (Lincoln & Guba, 1985). In this study, survey results were tabulated first, interviews were transcribed, and then the entire data set was reviewed and examined in order to identify patterns and emerging themes.

In addition to these primary data sources (surveys and semi-structured interviews) informal observations of interactions occurring between teacher participants throughout the course of the Reading were also recorded. These observations provided a more complete picture of the overall APES Reading experience.

Analysis of surveys. A major mistake often made in qualitative research is waiting until all data are collected before beginning analysis (Merriam, 1998). In this study, surveys were read as they came in each day and notes were made each evening after interviews were completed.

Upon returning from the Reading, data from the 60 surveys were reviewed question by question. All discrete data that could be numerically coded were entered into an SPSS data analysis program. All surveys were numbered before data were entered so that all responses could be tied to a particular respondent. After the survey results were entered, descriptive statistics were computed for each item. According to Glesne (1999), spreadsheets are helpful in tabulating data in an acceptable form for data analysis. Therefore, all descriptive statistics for appropriate survey items were entered into an Excel program for ease in producing tables.

A summary of open-ended comments and explanations was also compiled for responses to survey items asking respondents to elaborate or explain. These were typed into a list and read and reread several times looking for categories they might fit into. Categories were determined, comments placed under each category, and number of comments in each category tallied.

Analysis of interviews. At the end of each evening of interviews, I recorded my reflections and observations about participants, the interview setting, perceptions of the interviewees' comfort levels, and any interruptions and other factors I perceived might have influenced or affected the interview process or interviewee responses. The reading of surveys each day enabled me to learn more about each interviewee before conducting an interview with each respondent. Making notes about interviews each evening gave me

an opportunity to process information while it was fresh, and analysis of interviews allowed me to adjust and revise interview questions and pursue new areas in subsequent interviews (Rubin & Rubin, 2005).

Information on interviewing skills (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Yin, 2003) was reviewed each day in an attempt to discern errors and biases in my interviewing procedures and allow for improvement in interviewing techniques the next evening. “Qualitative researchers listen to hear the meaning of what interviewees are telling them” (Rubin & Rubin, 2005, p. 14). Hearing interviewees is “learning what is important to those being studied” (Rubin & Rubin, 2005, p. 15). Constant evaluation and reflection was required to really “hear” what each interviewee was saying.

When interviews were transcribed, names were changed to provide anonymity. As suggested by Merriam (1998), summary comments were made in the margin during the first reading of each interview. Glesne (1999), Spradley (1980), Merriam (1998), Rubin and Rubin (2005), and Yin (2003) all indicate that the next part of the process is to examine and categorize data, developing data codes or matching patterns. They suggest that perusing the data several times will result in smaller numbers of categories as similarities and connections become more obvious. Simple frequency counts of responses are helpful in identifying patterns in the data (Glesne, 1999).

Additional readings of the interview transcripts produced more clearly defined codes. Marshall (1981) indicated that these codes may include attitudes, feelings, and other chunks of meaning. Spradley (1980) referred to these codes as domains and proposed looking at small sections of notes at a time. Consequently, in my original

reading of the interviews, I looked at interview responses to each of the interview questions individually.

Codes and categories were not determined in advance because qualitative research is viewed as inductive, generative, and constructive (Goetz & LeCompte, 1981; Lincoln & Guba, 1985). Inductive analysis begins with the data, so codes and categories were developed from the interviews. Given that this was a case study, analysis concentrated on finding the essence or basic structure of the case and its underlying factors (Merriam, 1998; Moustakas, 1990).

Seventeen open-ended questions in 18 interviews generated an immense volume of data. Merriam (1998) and Glesne (1999) recommend reflecting upon the original purpose of the research in the process of managing the data. Therefore, I reread each interview with an eye to the three research questions I was seeking to answer during the study. Notes were made on post-it notes that were color coded for each research question. The color coded post-it notes were placed on the front of each interview for use in future coding and reference during the writing process.

Computers are also viewed as an important resource in data management (Glesne, 1999; Reid, 1992). Therefore, survey data from the post-it notes related to the three research questions were entered into a computer program and post-it notes on interview quotes perused to determine responses that were pertinent to each research question. Quotes from the transcripts were then placed under the appropriate research question with notes on which interviewee it was from and on what page it was found in their interview. I read the list of quotes several times to see what categories evolved. I then listed the categories, put quotes in each category, and reread the quotes to make sure they fit the

category. I again looked over the list of categories to determine any of them were similar enough to be combined. I then read through the quotes in each category looking for sub categories within each category. Because those interviewed were well known by many of the Reading participants, the grouping of data by research question instead of individual interviewee helped protect confidentiality.

Subjectivity

In order to manage my own subjectivities during the data collection, analysis, and synthesis process, I first sought to become aware of my personal subjectivities related to the focus of this study. Having participated in six previous APES Readings, I have formed my own opinions regarding their usefulness to me as a teacher and was aware of ways they have changed my personal pedagogical practice. As a result of my own participation as an APES Reader, I increased my knowledge of environmental science concepts and incorporated additional methods of assessment and teaching techniques upon returning to my APES classroom. I became aware of additional misconceptions that may have been held by my students and possible ways to overcome those misconceptions.

I also recognized that my years as a science teacher gave me a view of research that focused on quantifying data. This resulted in very specific and detailed data reporting in some sections of the study. My perception was that science teachers reading the research would identify with this method of reporting.

Being aware of subjectivity is essential in monitoring it (Glesne, 1999; Merriam, 1998; Rubin & Rubin, 2005). During the interviews, I always tried to ask for clarification of all ideas that were expressed. I was careful to phrase questions in ways that did not lead the interviewees to predetermined responses (Merriam, 1998; Rubin & Rubin, 2005).

Interviewees were told prior to the interview that additional questions might be asked in an effort to clarify and understand their response, not as an attempt to lead them to some forgone conclusion. Interviewees were also asked to check transcriptions of their interviews for accuracy and provide any correction or clarification they felt was necessary.

My own subjectivity was also of assistance to me in the analysis and discussion of results because recognition of my own subjectivity alerted me to the potential subjectivities held by each participant interviewed. When I sensed possible subjectivities, I pursued them with questions and attempted clarification. This intersubjectivity between me and the interview participants shaped aspects of the research as I was aware of the existence of these subjectivities.

Trustworthiness

Lincoln and Guba (1985, p. 290) state, “The basic issue in relation to trustworthiness is simple: How can an inquirer persuade his or her audiences (including self) that the findings of an inquiry are worth paying attention to, worth taking account of? What makes the research believable and acceptable?” The reader must be provided with enough information so that the conclusions of the study seem right to them (Firestone, 1987). Qualitative criteria of trustworthiness are open-ended, but there are techniques that can increase the concept of trustworthiness within qualitative research (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Rubin & Rubin, 2005).

One technique inherent in the process of increasing trustworthiness is member checking. People who provide the data are asked if the data are correct and if the interpretations and conclusions are reasonable (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Schwandt, 1997). In this study, interviewees were given the opportunity

to review their transcripts by way of email and provide corrections, clarification, and additional comments.

Another technique for ensuring trustworthiness is the production of an audit trail (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998; Schwandt, 1997). An audit trail includes record keeping and careful explanation of the procedures used to generate and analyze data (Schwandt, 1997). In this research study, daily fieldnotes were kept of observations and impressions. Interviews were transcribed, coded, and carefully cited in the analysis. Procedures and conclusions were reviewed by colleagues and doctoral committee members. This latter process is referred to as peer examination by Merriam (1998) or an external audit by Glesne (1999).

Clarifying researcher bias and subjectivity as discussed previously is also an important step in establishing trustworthiness (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998). I clarified my theoretical perspective at the beginning of the methodology section. This clarification is also an important step in establishing trustworthiness in qualitative research (Glesne, 1999; Lincoln & Guba, 1985; Merriam, 1998). The identification of subjectivities and theoretical perspectives, as well as the inclusion of member checking and an external audit, are qualitative methods used to increase validity in a qualitative study. They gave a more accurate understanding of the process and its interpretations and increased the trustworthiness of this study.

CHAPTER 4 RESULTS OF RESEARCH QUESTION 1

This chapter addresses results pertinent to Research Question 1: “What are the characteristics of teacher participants at the APES Reading and what are characteristics of veteran teacher participants who view the APES Reading as a positive professional development experience?” The information presented in this chapter is derived primarily from participant responses to survey items 1-13 and 18-20 (Appendix B). All 60 survey participants responded to these survey items except where noted. Responses to these items were compiled and analyzed item by item. In addition to survey data, portions of transcripts from interviews (Interview Protocol Appendix C) of 18 teacher Readers also provided insights regarding Research Question 1. See Appendix D for a brief description of interview participants.

Because no published research studies of APES teachers as a group currently exist, Research Question 1 endeavored to better understand the general professional characteristics of this group, their views of professional development, and demographic characteristics of those who choose to participate in the APES Reading. As I compiled basic data on age, gender, education, and teaching experience, I was able to determine these general characteristics and compare them to the characteristics of secondary teachers in general. In this study I determined that APES teacher Reading participants are older, more experienced, and have a higher level of education than secondary teachers in general.

As part of understanding the characteristics of this group, I also wanted to determine what subjects they taught and had taught in the past, their educational practice in terms of instruction and assessment techniques, and their educational philosophies. I found that APES Reading teacher participants use a wide variety of instructional techniques which is consistent with effective teachers in general. As was found in the literature review regarding Advanced Placement teachers, overall APES teachers also use a variety of assessment techniques, but their primary method of assessment is multiple choice or essay tests.

Educational philosophy incorporates beliefs, knowledge, values, perceptions regarding the teacher's role, and ideas about learning and how curriculum should be designed (Ornstein & Hunkins, 2004). In this study the areas of educational philosophy assessed primarily focused on perceptions regarding teacher's roles and student learning. It is my contention that the educational philosophy of participants can be partially constructed by assessing their professional practice. In addition to the educational philosophy specifically stated by participants in survey comments and interview responses, their reported commitment to teaching and education also provided insights regarding their professional practice and educational philosophy. Therefore, participation in nondegree related college coursework, professional development participation, magazine subscriptions, membership and participation in professional organizations, professional service, awards received and participation in previous APES Readings were all viewed as indicators of the educational philosophy of participants in the study.

Their stated views of education as an ongoing, student centered process were supported by their high level of participation in additional nondegree related college

coursework and professional development activities. The view of education as an ongoing process was also supported by their large number of subscriptions to professional magazines and their participation in a variety of professional organizations. The multiple professional awards received by participants served as an indication of their strong commitment to the educational profession. Their high level of commitment to professional service was an indication of their desire to improve the education profession.

Results for Research Question 1 are presented and discussed in the following categories: Demographic Information/Experience, Employment History, and Educational Practice and Philosophy.

Demographic Information/Experience

Information related to teacher demographics and experience was obtained from items 18-20, 25-27, and 28-29 on the survey. These items asked teachers to provide their age, gender, education level, non-degree related college coursework, years teaching at their current school, total years of teaching experience, and sections of APES they taught this past year.

Age/Gender

Information about age and gender was assessed on questions 18 and 19 of the survey. Of the 114 teachers attending the 2004 APES Reading, 51% (58) were female and 49% (56) were male. Of the 60 participants responding to the survey, 30 were female and 30 were male. Thus, the teacher participants in this study sample were representative of the sex ratio of all teacher participants attending the 2004 APES Reading. The youngest teacher participant in this study was 31 and the oldest was 62 with an average age of 48. Age characteristics of teacher participants surveyed are summarized in Table 4.1.

Table 4.1 Age of APES Reading Participants Surveyed

Characteristic	N	Range	Minimum	Maximum	Mean	Standard Deviation
Age (Years)	60	31	31	62	47.78	7.78

Education

Information about education level, subject area specializations, and non-degree related coursework was obtained from questions 20, 28, and 29 on the survey. Table 4.2 summarizes the educational levels of APES teachers surveyed. Of a total sample of 60 teacher participants, 59 had bachelor's degrees, 41 had master's degrees, and 3 had PhD degrees. One participant did not fill out the section on college degrees.

Table 4.2 College Degrees Held by APES Reading Participants Surveyed (N = 60)

Degree Level	Number of Participants
Bachelor's Degree	59
Master's Degree	41
Ph.D.	3

Tables 4.3-4.5 summarize the most common subject area specializations of the college degrees held by APES Reading participants surveyed. Twenty-seven (45%) of the Bachelor's degrees were in biology or biology education, eight (13%) were in geology, five (8%) were in chemistry, four (7%) were in science education, four were in environmental science, three (5%) were in microbiology, and three were in general education. Other subject areas each reported only once for bachelor's degree majors included biochemistry, botany, earth science, ecology, entomology, geography, German, integrated science, and zoology.

Forty-one (68%) of the APES teacher participants surveyed also held master's degrees. Nine (15%) were in science education, six (10%) were in biology or biology education, six were in environmental science or environmental science education, five (8%) were in general education, and three (5%) were in geology. Other master's degree

majors that were listed once each included agriculture, aquatic ecology, business, chemistry, curriculum and instruction, earth science, educational leadership, genetics, integrated science, international policy studies, marine science, and physiology.

Three (5%) of the participants also had doctoral degrees. The Ph.D. degrees were in chemistry, genetics, and geology. All participants did not list years in which they obtained their degrees, but the years participants did list ranged from 1969 to 2002.

Table 4.3 Bachelor's Degree Subject Area Specializations of APES Reading Participants Surveyed (N = 60)

Bachelor's Degree Major	Number of Participants
Biology/Biology Education	27
Geology	8
Chemistry	5
Environmental Science	4
Science Education	4
General Education	3
Microbiology	3

Table 4.4 Master's Degree Subject Area Specializations of APES Reading Participants Surveyed (N = 60)

Master's Degree Major	Number of Participants
Science Education	9
Biology/Biology Education	6
Environmental Science/Environmental Science Education	6
General Education	5
Geology	3

Table 4.5 Ph.D. Degree Subject Area Specializations of APES Reading Participants Surveyed (N = 60)

Ph.D. Degree Major	Number of Participants
Chemistry	1
Genetics	1
Geology	1

In addition to college degree levels and areas of specialization, participants surveyed also cited non-degree related college coursework completed (Table 4.6). Forty-seven (78%) of the 60 participants have completed non-degree related college coursework while 13 (22%) have not pursued non-degree related college coursework. Of

those who have completed non-degree related college coursework, 36 have taken science courses and 28 have taken education courses. Science courses completed ranged from 1 to 60 with an average of 12 while the number of education courses completed ranged from 2 to 30 with an average of 7. Because of the large numbers reported by several participants, it appears some were listing number of hours of college coursework completed instead of the number of courses taken.

Table 4.6 Non-Degree Related College Coursework Completed by APES Participants Surveyed (N = 60)

Area of Coursework	Number of Participants	Percent of Participants	Average Number of Courses
Science	36	63	12
Education	28	52	7
Total	47	78	

Experience

Years of teaching experience, teaching experience at their current school, and number of sections of APES taught during the past year were assessed by survey items 23, 25, 26, and 27 (Table 4.7). The minimum amount of teaching experience reported was four years while the maximum was 44 years with an average of 19 years of teaching experience. Participants in this study have been teaching at their current school for 2 to 37 years and the average number of years at their current school is 13. The number of sections of APES taught during this past year ranged from zero to six with the average being less than two sections. The two teachers who reported teaching no sections of APES during the past year indicated that they teach APES every other year at their school.

Table 4.7 Teaching Experience of APES Reading Participants Surveyed

Characteristic	N	Range	Minimum	Maximum	Mean	Standard Deviation
Years of Teaching Experience	60	40	4	44	19.17	9.43
Years at Current School	60	35	2	37	13.20	9.81
Sections of APES Taught Last Year	60	6	0	6	1.72	1.21

The participants surveyed were also asked to list other advanced courses they have taught besides APES. Thirty-seven (62%) are currently teaching or have taught other AP courses, 31 (52%) teach or have taught honors courses, and 2 (3%) teach or have taught IB courses. Twenty-one (35%) do not teach and have never taught any other advanced courses besides APES. The most common additional AP course taught is biology and the most common honors course taught is also biology. One of the additional International Baccalaureate (IB) courses taught is biology and the other is environmental systems. Information about other advanced courses taught is summarized in Tables 4.8-4.10.

Table 4.8 Other AP Courses Taught by APES Reading Participants Surveyed (N = 60)

AP Course	Number of Participants
AP Biology	23
AP Chemistry	9
AP Physics	4
AP Economics	1
Total	37

Table 4.9 Honors Courses Taught by APES Reading Participants Surveyed (N = 60)

Honors Course	Numbers of Participants
Biology	10
Anatomy/Physiology	2
Chemistry	2
Earth/Space Science	2
Global Ecology	2
Microbiology	2
Research	2
Aquatic Marine Science	1
Bioethics	1
Biomedical	1

Table 4.9 Continued

Honors Course	Numbers of Participants
Botany	1
Physical Science	1
Physics	1
Psychobiology	1
Planet Earth	1
Zoology	1
Total Honors	31

Table 4.10 International Baccalaureate (IB) Courses Taught By APES Reading Participants Surveyed (N = 60)

International Baccalaureate (IB) Course	Number of Participants
Biology	1
Environmental Systems	1
Total	2

Of the 70 non-APES advanced courses taught, 44 are biological sciences and 20 are physical sciences. Six advanced courses are taught in other subject areas. The total number of non-APES advanced courses taught by the 60 study participants is summarized in Table 4.11.

Table 4.11 Number of Non-APES Advanced Courses Taught By APES Reading Participants Surveyed (N = 60)

Number of Courses	Number of Participants
0	21
1	20
2	12
3	5
4	1
7	1

Summary of Demographic Information/Experience Results

The gender ratio of participants in this study was 51% female and 49% male. No participant in this study was under age 30 and the average age of APES teachers surveyed was 48. Sixty-eight percent of the teachers surveyed in this study have master's degrees and five percent of the teachers in this study have Ph.D. degrees.

In this study, biology was the most common undergraduate major of APES teachers (45%). The fact that biology is the most common undergraduate degree major of APES teachers also helps to explain why biological sciences are the largest category of other advanced courses taught. Biological sciences comprised almost 50% of the other advanced science courses taught by participants in this study.

Employment History

Education-related and science-related employment was addressed by items 21 and 22 on the survey. Item 21 asked participants about their education employment including their job title, state in which they taught, subjects taught, and years of employment. Item 22 asked participants about their science-related employment including job title, state of employment, and years of employment.

Education-Related Employment

The 60 survey participants listed education employment in one or more of the following areas: teacher (59), department chair (14), curriculum assessment developer (1), instructional dean (1), and marine education director (1). Teachers also reported the states in which they taught. The 23 states listed were spread across all regions of the country. The states with the greatest number of APES teacher participants were California (10), North Carolina (8), Texas (7), Massachusetts (6), Florida (5), and New Jersey (5).

In addition to APES, the most common subjects taught by the 60 participants in this study were biology (37), chemistry (24), physics (17), earth science (12), environmental science (12), middle school science (9), physical science (8), and geology (7).

Information regarding years of employment was difficult to assess because many participants left the response column blank or listed years and put a question mark by

them. Some participants listed a series of years and others listed the different subjects currently taught and a different set of years by each subject. All of these variables made any clear analysis of years of teaching specific subjects impossible.

Science-Related Employment

Two-thirds of the 60 participants in this study listed some type of science-related employment. The top areas of science-related employment included adjunct professor (14), laboratory technician (7), outdoor/naturalist guide (6), APES consultant or workshop leader (5), other science consultant (3), and science researcher (3). There was also one listing for each of the following: agricultural commodity grader, camp director, chemist, computer programmer/analyst, editor/indexer biological abstracts, food quality inspector, geologist, medical technologist, veterinary technician, water treatment plant operator, wildlife biologist, wildlife trainer, and zookeeper. Table 4.12 summarizes the top six areas of science-related employment.

Table 4.12 Science-Related Employment History of APES Reading Participants
Surveyed (N = 60)

Type of Employment	Number
Adjunct Professor	14
Laboratory Technician	7
Outdoor/Naturalist Guide	6
APES Consultant	5
Researcher	3
Science Consultant	3

Summary of Employment History Results

All but one APES Reading participant listed their employment as teacher. Twenty-three percent of those teachers are department chairs, but only three listed any other educational employment. The other educational employment areas listed by study participants still enable the participants to also function as teachers. Only 23 states were represented, but they did include all regions of the country.

Educational Practice and Philosophy

The 60 APES teacher participants in this study provided information about their actual educational practice (survey items 3-11) and their educational philosophy (survey items 30-34).

The subset of 18 participants interviewed in this study provided additional insights regarding their educational philosophy when they shared their views of teacher and student roles in education. The majority of these insights were part of responses to interview questions 1-4 which asked: “What is your definition of effective science teaching?” “What practices would you expect to see in an effective science teacher’s classroom?” “At this point in your career, how close are you to this vision of an effective science teacher?” and “What factors/experiences have helped you in reaching this vision of an effective science teacher?”

Educational Practice

Survey items 3-8 asked participants to provide information about instructional techniques, teaching resources, and assessment techniques used in the classroom. Items 9-10 on the survey were Likert-type questions which asked participants to rate their comfort level regarding pedagogical practice and environmental science knowledge.

Instructional techniques. The 60 APES teachers surveyed listed between 5 and 13 different instructional methods with an average of 9 methods per study participant. The most common instructional methods listed were lab activities (59), videos (57), discussion (56), field trips/outdoor activities (55), lecture (55), and cooperative learning (51). Types of instructional techniques listed by more than one participant are included in Table 4.13. Instructional techniques listed only once by participants were: application, assigned readings, current events, independent study, and practice exams.

Fifty-four of the 60 participants surveyed indicated which instructional techniques they used most often, second most often, and third most often. Twenty-six of the 54 listed lecture as the instructional method most often used in their classroom followed by 20 participants who listed discussion as the instructional method most often used. Thus, 46 (77%) of APES teachers surveyed used verbal methods of lecture or discussion as their primary form of instruction. In addition, 40 of the 54 participants listed lecture as one of their top three instructional techniques.

Lab activities were listed as one of the top three instructional techniques used by 45 of participants surveyed, but only 12 listed lab activities as the most often used method of instruction. The five instructional techniques most often ranked first, second, or third by participants are summarized in Table 4.14.

Table 4.13 Instructional Techniques Used by APES Reading Participants Surveyed (N = 60)

Instructional Technique	Number of Participants
Lab Activities	59
Videos	57
Discussion	56
Field Trips/Outdoor Activities	55
Lecture	55
Cooperative Learning	51
Computer Programs	43
Worksheets	42
Demonstrations	37
Debates	29
Drawing Activities	25
Role Play	19
Projects/Presentations	6
Internet-based Activities	4
PowerPoint Presentations	3
Case Studies	2
Student Designed Essays	2

Table 4.14 Instructional Techniques Ranked First, Second, or Third by APES Reading Participants (N = 60)

Instructional Technique	Rank		
	First	Second	Third
Lecture	26	11	4
Discussion	20	7	6
Lab Activities	12	21	12
Cooperative Learning	6	8	9
Field Trips/Outdoor Activities	3	6	9

Teaching resources. The 60 APES participants surveyed reported using 14 different resources in their APES classrooms. Participants each listed between zero and eight different resources, with an average listing of five resources per study participant. The most common teaching resources used by APES teachers include Internet/websites (55), science-related newspapers/magazines (54), science reference books (35), lab manuals (34), AP Central (29), and other teachers (27). Teaching resources listed by more than one participant are summarized in Table 4.15. In addition to resources listed in Table 4.15, APES workshops, computer software programs, local newspapers, and maps were each listed by one participant.

Table 4.15 Teaching Resources Used by APES Reading Participants Surveyed (N = 60)

Teaching Resource	Number of Participants
Internet/Websites	55
Science-Related Newspapers/Magazines	54
Science Reference Books	35
Lab Manuals	34
AP Central	29
Other Teachers	27
Environmental Programs (GLOBE, Earth Day)	2
Guest Speakers	2
Textbooks/Books	2

Survey item 6 asked participants to rank the three resources they used most often in their APES classrooms. Fifty-five participants responded to this question. The four most common resources ranked are summarized in Table 4.16. The textbook was ranked first

by the vast majority of participants surveyed (41). The Internet/websites was ranked as first choice by eight teacher participants, followed by science-related newspapers/magazines, and lab manuals/other labs. Ten of the participants surveyed ranked more than one resource as their most commonly used resource.

Table 4.16 Teaching Resources Ranked First, Second, or Third by APES Reading Participants Surveyed (N = 60)

Resources	Rank		
	First	Second	Third
Textbook	41	3	2
Internet/Websites	8	17	17
Science Related Newspapers/Magazines	7	24	9
Lab Manual/Other Labs	5	9	8

Participants were also asked to name the primary textbook used in their APES classes. Living in the Environment by G. Tyler Miller was the most common text used and was listed by 33 participants. A distant second to Miller was Environment by Raven, Berg, and Johnson (9), Environmental Science: A Global Concern by Saigo and Cunningham (6), Environmental Science by Botkin and Keller (5), and Environmental Science: Toward a Sustainable Future by Nebel and Wright (4). The study participants did not provide the years of publication of their textbooks so it was not clear which edition of these textbooks were being used. Eight of the teachers surveyed reported using multiple textbooks in their APES classes.

Assessment techniques. Participants surveyed each use a variety of assessment techniques with a range of 2 to 10 different assessment methods for each participant (Table 4.17). The average number of assessment techniques used by APES teachers was six. The majority of participants surveyed use five (17), six (18), or seven (12) types of assessments in their APES classes. Fourteen different assessment methods were listed by study participants.

Table 4.17 Number of Assessment Techniques Used by APES Reading Participants Surveyed (N = 60)

Number of Assessments	Number of Participants
2	1
3	1
4	4
5	17
6	18
7	12
8	6
9	0
10	1

Essay/free response tests and multiple choice tests are the assessment techniques used most often by APES teachers surveyed. Each of these assessment techniques was listed by 59 of the 60 participants surveyed. The assessment technique used second most often by study participants was individual/group projects (54), followed by lab reports (53), and homework assignments (47). A summary of all assessment techniques used by more than one participant is included in Table 4.18. Lab questions, pretests, reading assignments teaching/observations, and vocabulary tests/quizzes were assessment techniques each used by only one APES teacher surveyed.

Table 4.18 Assessment Techniques Used by APES Reading Participants Surveyed (N = 60)

Assessment Technique	Number of Participants
Essay/Free Response Tests	59
Multiple Choice Tests	59
Individual/Group Projects	54
Lab Reports	53
Homework Assignments	47
Research Papers	33
Short Answer/Fill in Blank Tests	17
Open Note Tests	11
Student Portfolios	8
Quizzes on Portions of Chapters	4
True/False Tests	3
PowerPoint Presentations	2
Case Study Analysis	2
No Response	6

When asked to rank the assessment techniques they use most often, five either did not rank the assessments at all or gave all assessment techniques used the same ranking. Of the 55 participants who did rank their assessment techniques, 35 (64%) use multiple choice tests as their primary form of assessment. Twenty-five of the 55 (45%) participants use essay tests as their primary assessment technique. The total of those ranking these two types of assessments as the most frequently used technique is greater than 100% because some teachers ranked more than one assessment method as first, stating that they use two or more assessment techniques equally. Homework assignments (15), lab reports/notebooks (6) and projects (6) were also among the assessment methods ranked first. Multiple choice tests were ranked as the first, second, or third most used assessment technique by 44 of participants. Essay tests were ranked as one of the top three most used assessment techniques by 43 participants. Table 4.19 summarizes the five assessment techniques ranked first, second, or third.

Table 4.19 Assessment Techniques Ranked First, Second, or Third by APES Reading Participants Surveyed (N = 60)

Assessment Technique	Rank		
	First	Second	Third
Multiple Choice Tests	35	3	6
Essay Tests	25	12	6
Homework Assignments	15	7	7
Lab Reports/Notebooks	6	20	11
Projects	6	14	12

Comfort level regarding pedagogical practice and environmental science

knowledge. Survey items 9-10 asked APES teachers to rank their perceptions of their pedagogical practice and environmental science knowledge as “very comfortable” (VC), “somewhat comfortable” (SC), “somewhat uncomfortable” (SU), and “very

uncomfortable” (VU). Participants were also given an opportunity to provide additional comments about their pedagogical practice and environmental science knowledge.

Regarding pedagogical practice, 59 participants responded. All of them checked either “very comfortable” (38) or “somewhat comfortable” (21). On a scale of 1 to 4 with 1 representing “very comfortable” and 4 representing “very uncomfortable” the range of responses was 1 to 2 with a mean of 1.36.

Twelve participants wrote comments about their level of comfort with their pedagogical practice. Seven of those who commented indicated they were “very comfortable” with their current pedagogical practices. The following are some comments written by those who indicated they were “very comfortable” with their pedagogical practice. Jane wrote, “I just finished an administration/supervision degree.” Richard wrote, “I have taught ecology and environmental science for thirty years.—Still love it.” Bob wrote, “I feel very comfortable but am always open to/interested in learning more!”

Five of study participants who wrote comments chose “somewhat comfortable” as their comfort level with their pedagogical practice. The following are some comments written by those who indicated they were “somewhat comfortable” with their pedagogical practice. Allison wrote, “I’ve had very little training in this area. Most of it I have learned on my own.” Beverly wrote, “Teaching techniques change to reflect standardized testing.” Sherry wrote, “I feel I’m a little out of touch with the latest buzzwords. I teach all AP—very content driven.” Mary wrote, “I am comfortable with summative assessment but not formative assessment. I also would like to figure out how to motivate my students better.” The distribution of responses pertaining to comfort levels regarding pedagogical practice is summarized in Table 4.20.

Regarding environmental science knowledge, the 60 study participants felt “very comfortable” (49), “somewhat comfortable” (9), and “somewhat uncomfortable” (2). The range of responses to this item was from 1 (very comfortable) to 3 (somewhat uncomfortable) with a mean of 1.22.

Eighteen participants provided comments about their comfort levels regarding environmental science knowledge. The following comments are examples of the responses provided by 15 participants who were “very comfortable” with their environmental science knowledge. Paul wrote, “But I’m always learning.” Sherry wrote, “I’m very comfortable with basic science concepts, but somewhat comfortable with some specific environmental science (pollutants, statistics).” Patricia wrote, “I’m comfortable to the level that I need to teach, but perhaps I am not as expert in soil chemistry as some fellow graders.” Gary wrote, “I don’t know everything, but I feel pretty good about the basics.”

Two participants who responded “somewhat uncomfortable” provided comments. Morrie wrote, “There is always something to learn. It is such a challenge to stay current.” Mary wrote, “I feel comfortable in the areas in which I have more formal training and interest and less comfortable with the things I am least trained in.” Sandra was the only participant providing a “very uncomfortable” response who wrote a comment. She wrote, “I co-teach the course with my emphasis on life science. I feel lacking in the components I don’t teach.” The results of comfort level in environmental science knowledge are also summarized in Table 4.20.

Table 4.20 APES Reading Participants' Comfort Levels Regarding Pedagogical Practice and Environmental Science Knowledge (N = 60)

Area of Focus	Very Comfortable	Somewhat Comfortable	Somewhat Uncomfortable	Very Uncomfortable
Pedagogical Practice	38	21	0	0
Environmental Science Knowledge	48	9	2	1

Summary of Educational Practice Results

The APES teachers in this study use a wide variety of instructional techniques in their APES classes, including lab activities, videos, discussions, field trips/outdoor activities, lecture, and cooperative learning. The sixty participants surveyed also listed computer programs (72%), worksheets (70%), and/or demonstrations (62%) as instructional methods used in their classroom. However, when asked to indicate which instructional techniques they use most often, APES teachers rely heavily on traditional verbal methods of lecture and discussion. Consistent with what might be expected in a lab-based science course, 83% of the APES teachers in this study listed lab activities as one of their top three instructional methods used.

The APES teachers in this study use a variety of resources in their classroom teaching. Over half use the Internet or websites, science-related newspapers and magazines, science reference books, and lab manuals. However, when participants were asked to rank the resources most often used, they overwhelmingly reported using the textbook as the primary teaching resource. Approximately three-fourths of the participants surveyed listed the textbook as their most often used instructional resource.

APES teachers in this study also use of a variety of techniques to assess student learning. Just over three-fourths of the participants surveyed use four to six different

assessment methods in their APES classes and the average number of assessments used by study participants was six. Once again, when participants were asked to identify the assessment methods used most often in their APES classes, they reported a significant focus on more traditional assessment techniques such as multiple choice tests and essay tests.

The vast majority of study participants reported feeling comfortable with their pedagogical practice (100%) and environmental science knowledge (95%).

Educational Philosophy

As indicated previously, in addition to the educational philosophy specifically stated by participants in survey comments and interview responses, professional development participation, magazine subscriptions, membership and participation in professional organizations, professional service, awards received and participation in previous APES Readings were all viewed as indicators of the educational philosophy of participants in the study. These areas were addressed in items 30-34 on the survey. In addition to the responses of the 60 survey participants to these questions, interview participants' perceptions of their educational philosophy were derived from participant responses in the interviews conducted with 18 of the participants in the study.

Professional development participation. Item 31 on the survey asked participants to list attendance or presentation at professional development conferences and their years of participation. Fifty-seven of the 60 APES teachers reported involvement in professional development activities. Thirty participants surveyed indicated whether the professional development activity was a national conference, state conference, inservice workshop, summer institute, or multi-day enrichment program, but did not provide specific names of conferences or activities in all of the categories they checked.

Approximately one-half of the participants surveyed provided information regarding years they participated in professional development. A summary of professional development activities completed by study participants is listed in Table 4.21.

Table 4.21 Professional Development Activities of APES Reading Participants Surveyed (N = 57)

Professional Development Activity	Attended	Presented
National Conference	36	24
AP Workshop/Institute	30	27
State Education Conference	29	19
Other Multi-day Workshop/Institute	19	12
Inservice Workshop	17	12
Curriculum Training Workshop	8	0
Other Institute	4	3
Total	143	97

The most common type of professional development activity completed by APES teachers was attendance at a national education conference (36). The most frequently listed national conferences included the National Science Teachers Association, National Association of Biology Teachers, National Earth Science Teachers Association, International Society for Technology in Education, and the American Association of Physics Teachers. The second most common professional development activity completed by study participants was attendance at AP workshops and institutes (30). AP workshops and institutes also had the greatest number of presentations by the APES teachers surveyed (27).

A number of participants surveyed have attended state education conferences (29), other multi-day conferences (19), inservice workshops (17), curriculum training workshops (8), and other unspecified institutes (4). State conferences listed included California, Florida, Indiana, New Jersey, Tennessee, Texas, and Virginia. Institutes attended by study participants included the Earth Watch Institute, Geographic Institute,

and Technology Education Summer Institute. Curriculum training workshops attended by study participants included GLOBE, NOAA, Project Learning Tree, and Project WILD.

Magazine subscriptions. Item 32 on the survey asked participants to list professional magazines to which they subscribed. Forty-eight different magazines were listed. The total number of subscriptions reported by the 60 study participants was 123 with a range of zero to six and an average of two magazine subscriptions per participant. The magazines listed were grouped into the categories of general science/science education (64), biology/biology education (26), environmental advocacy groups (12), physical science/science education (11), environmental science (5), and general education (5). A summary of professional magazine subscriptions of study participants is provided in Table 4.22.

Table 4.22 Magazines Subscriptions of APES Reading Participants Surveyed (N = 60)

Magazine Category	Number of Subscriptions
General Science/Science Education	64
Biology/Biology Education	26
Environmental Advocacy Organizations	12
Physical Science/Science Education	11
Environmental Science	5
General education	5
Total Subscriptions	123

The most common category of magazine subscriptions reported was general science/science education. This category included magazines such as The Science Teacher (24), Discover (11), Scientific American (9), and Science News (5). The second most common category of magazine subscriptions listed was biology/biology education. American Biology Teacher was cited by the largest number of participants in this category with 16 subscriptions. Participants surveyed listed 12 subscriptions to

magazines of various environmental advocacy groups, including Sierra (6), Worldwatch (3), Nature Conservancy (2), and Wild Earth (1).

Eleven study participants subscribed to physical science/science education magazines. The nine different magazines listed in this category included The Journal of Chemical Education (2) and The Physics Teacher (2). Participants listed five total subscriptions to environmental science magazines. Two participants subscribed to Environment and one each subscribed to three other environmental science magazines. Five participants also subscribed to general education magazines. No one general education magazine had more than one subscription by the study participants.

Membership and participation in professional organizations. Item 33 on the survey asked participants to provide information about their membership in professional organizations. The 56 participants responding reported memberships in 27 different professional organizations. The number of professional organization memberships for APES teachers ranged from zero to seven with an average of two organization memberships per participant. Professional organization memberships were grouped into national science teacher organizations (55), state/regional science teacher organizations (35), environmental education organizations (16), science organizations (3) and other organizations (1).

Fifty-five of the 60 participants surveyed are currently members of national science teacher organizations with the National Science Teachers Association having the largest number of members (34). Thirty-five study participants are members of state/regional science teacher organizations. Specific state organizations listed were from California, Florida, Indiana, New Jersey, Tennessee, Texas, and Virginia.

Sixteen study participants are members of environmental education organizations with the North American Association of Environmental Educators cited as the most common environmental education organization. Three study participants are members of science organizations including the American Society for Microbiology, American Chemical Society, and the American Geophysical Union. The only “Other” listed was the National Association of Independent Schools.

Only 8 of the 60 participants surveyed hold or have held a leadership role in a professional organization. The most common type of organization in which APES teachers have a leadership role is state/regional science teacher organizations (5). Information regarding professional organization memberships is summarized in Table 4.23.

Table 4.23 Professional Organization Memberships of APES Reading Participants Surveyed (N = 56)

Types of Professional Organization	Current Member	Leadership Role
National Science Teacher	55	1
State/Regional Teacher	35	5
Environmental Education	16	1
Science	3	0
Other	1	1
Total Membership	110	8

Professional service. Survey item 30 asked participants to list areas of professional service. Thirty-eight study participants responded to this item. Those who responded listed from one to five areas of professional service. The most common type of professional service listed was service as a mentor teacher (33). The second most common type of professional service reported was intern/student teacher supervisor (24). Two participants listed workshop presenter and six checked “Other” without giving an explanation. Science convention presenter, APES test developer, science fair sponsor,

Florida Junior Academy of Science presenter, state science coordinator, and environmental club sponsor were each reported by one participant.

The number of years participants reported serving as mentor teachers ranged from 1 to 10 with a mean of 3 and the number of years participants reported serving as intern/student teacher supervisors ranged from 1 to 11 with an mean of 3 years.

Professional service information is summarized in Table 4.24.

Table 4.24 Professional Service Activities of APES Reading Participants Surveyed (N = 38)

Professional Service Activity	Number of Participants
Mentor Teacher	33
Intern/Student Teaching Supervisor	24
Workshop Presenter	2
Science Convention Presenter	1
APES Test Developer	1
Science Fair Sponsor	1
FJAS State Coordinator	1
Environmental Club Sponsor	1
Other, No Explanation	6

Awards received. Forty-two of the 60 APES teacher participants surveyed responded to item 34 regarding awards received. A total of 65 awards were reported by 39 of the APES teacher participants surveyed. Responses from three participants could not be deciphered. The number of awards received by participants surveyed ranged from 0 to 11 with an average of 1.77 awards per study participant. Awards received were grouped into the following categories: school teacher of the year (21), national level award (20), state level award (8), national board certification (6), county/district teacher of the year (3), regional teacher of the year (1), and college/university distinguished teacher (1). Three participants listed fellowships and two participants listed “Who’s Who Among American Teachers.” These last two items were not considered awards as defined in this study and were not included in the awards tally.

National awards listed by participants in the study included three Tandy Tech National awards, two Siemens AP awards, two AP College Board awards, one Westinghouse award, one Outstanding Biology Teacher award, one Presidential award and ten other national awards. Information regarding awards reported by participants surveyed is summarized in Table 4.25.

Table 4.25 Awards Received by APES Reading Participants Surveyed (N = 42)

Award Category	Number of Awards
School Teacher of the Year	21
National Level Award	20
State Level Award	8
National Board Certification	6
County/District Teacher of the Year	3
College/university Distinguished Teacher	1
Regional Teacher of the Year	1
Total	60

Participation in previous APES Readings. APES Readings have taken place each June since June, 1998. Fifty-three of the 60 APES teachers surveyed have participated in at least one previous APES Reading. Each year, the number of teacher participants in the Reading has increased. Of the participants surveyed in 2004, 46 had attended the 2003 Reading, 37 had attended the 2002 Reading, and 36 had attended the 2001 Reading (Table 4.26).

Table 4.26 Previous APES Reading Experience of APES Reading Participants Surveyed (N = 53)

Year of Reading	Number of Participants
1998	10
1999	19
2000	25
2001	36
2002	37
2003	46

The number of years of previous participation ranged from zero to seven with an average of 3.88 (Table 4.27). Twelve of the 2004 APES Reading participants surveyed

have participated in two previous Readings, 11 have participated in 4 previous Readings, and 10 have participated in 6 previous Readings. In addition to participation in previous APES Readings, four participants have also participated in AP Biology Readings.

Table 4.27 Number of Previous APES Readings Attended by APES Reading Participants Surveyed (N = 53)

Number of Previous APES Readings	Number of Participants
1	7
2	12
3	8
4	11
5	5
6	10
7	7

Interview participants' perceptions of their educational philosophy. All 18 participants interviewed reported that professional development was important for effective teaching. During the semi-structured interviews of 18 APES teacher participants in this study, additional insights were obtained regarding the study participants' philosophy of the roles of teachers in the education process. Ten participants interviewed understood teacher roles as exposing students to concepts and ideas, guiding and coaching, constantly learning, having command of subject matter, caring about students and using a variety of pedagogical techniques. Seven of the interview participants saw teachers as needing to constantly learn and change and be passionate and excited about teaching. Six of the participants responded that teachers should enable students to: construct their own learning, explore, create, discover, and engage in their learning. Three participants also mentioned that teachers should prepare students to be good citizens as they grow.

Teacher comments about educational philosophy were focused on what teachers do and how students learn. They shared that teachers should be lifelong learners, learning is

student centered, and teachers must use a variety of instructional and assessment techniques.

Teachers should be lifelong learners. I asked Tom, “What characterizes effective science teaching?” He answered, “Always keeping up on your own professional development, willing to take risks to stretch your own self.” Carl replied, “Effective teachers are the ones who have an interest in the topic, who maintain that interest, who participate in professional development activities like the APES Reading or a conference or something else.” I asked Ben, “What do you see as an effective science teacher?” In his response he stated, “use a constructivist approach and give students opportunities to explore and create together. . . learning is a lifelong process. . . life is a journey and so is education.”

Learning is student centered. Kathy responded that an effective teacher is, “someone who understands kids first of all and then someone who knows their subject matter well and has the ability to excite their kids about it, to involve their kids.” Nancy replied, “effective teachers make students, invite students, to think about things and to really be able to relate things to nature whatever that nature is.” Sue answered,

First of all I think you must be amazed with the world and have curiosity yourself, you have to have a little humor, you have to have a broad knowledge, you have to be able to improvise with the struggles of the kids, you have to have enough love to want to make it work.

I asked Marlene, “Are there changes that you’d like to make in your APES teaching?” She referred to the need to “make learning more relevant to student’s lives.” I asked Sue, “Is there anything else about teaching or your practices you would like to share?” She replied, “I want to put more emphasis on the students. I don’t teach subject matter, I teach students.” Marlene shared, “I’m not teaching APES, I’m teaching kids.

I'm teaching kids how to think" Pam said, "I worked hard for the kids. I want to make sure that they know that I care about them, deeply" Bart responded, "I like to make teaching relevant. I'm energized. On year end evaluations, I'll get comments like, 'I didn't know you could have fun and learn at the same time.' I love the subject matter."

Denise responded to the question, "What makes an effective science teacher. She said, "Every teacher has to constantly learn and improve. They must constantly keep up with education practices. They must go to experiences like different workshops and conventions." Sue responded that an effective teacher must prepare students for the future. She said, "Students are going to be our citizens and we've got to prepare them for the industry or college." In his response to characteristics of an effective science teacher, Larry also referred to preparing students for the future. He replied, "I teach my students to be good consumers. In order for them to make good decisions about their impact on the environment and so on, they've got a lot to learn."

As can be seen in some of the above quotes and those that follow, interview participants saw student learning as active. Larry responded to the question, "What factors or experiences come to mind that maybe have moved you forward toward that goal of an effective science teacher?" He talked about his view of students as "active learners." He stated, "It is science. You have to be active in it and having a situation where kids just sit every day, doesn't really meet the true honor of what the word science means."

Teachers must use a variety of instructional and assessment techniques.

Participants also viewed students as responding to a variety of instructional techniques. I asked Jane, "What do you see as an effective science teacher?" She replied, "engaging

kids, a lot of hands on activity”. Bob replied, “gets kids excited about science, about learning. . .find out what kids are interested in and what’s relevant to them.” Bart stated, “I think the best way is experiential learning and it doesn’t always have to have beakers and test tubes. Making it relevant would be the other thing for me.”

When I asked Carl about characteristics of effective science teachers, he answered, “Have activities designed to engage students.” Sue also responded, “You need to be there as a leader, as a mentor, as a person who helps them along the way.” David stated,

Provide students some guidance and coach them. Let them use what they know to actually discover what they know to build some concepts in science. . . expose students to concepts and ideas. . . I should be reflective about what I’m doing and keep learning new ways and different ways to do things.

Allison answered that effective teachers provide, “a good blend of lecture, lab, video, hands-on because too much of any one thing just really turns the kids off.” Pam said,

I think the most effective teacher changes what you do so that all types of learners are actively engaged in the process. You need to incorporate labs, show them practical applications of how this affects your life, do videos, labs and all sorts of things.

I asked Kathy “What types of assessments do you do?” Her response was a clue to her idea of student learning when she answered, “Students learn by doing.” I asked Marlene, “Are there changes that you’d like to make in your APES teaching?” Her answered clarified her idea of student learning when she said, “I’d like to make kids take more responsibility for their own learning.”

Summary of Educational Philosophy Results

The need for continued learning and improvement was viewed as important by APES Reading teacher participants. This view is supported by the large number of professional development activities completed by the APES teachers surveyed. Their

commitment to ongoing professional development was also reflected in their comments during interviews. Over half of the APES teachers surveyed have attended national conferences and AP workshops/institutes and just under half (29) have attended state education conferences.

Evidence of the commitment to ongoing learning and improvement is also found in the large number of magazine subscriptions reported. The average number of magazine subscriptions related to science and/or science teaching was two per participant. The magazines received by participants surveyed are among the most notable and highly regarded journals in their fields. In addition, one participant indicated that she does not currently subscribe to any magazines because the school library subscribes to them and they can be read there in the school library. Other participants surveyed may also read science and education magazines in their school library or, online. Therefore, the number of professional magazines read might be underreported.

Participants surveyed also exhibited a strong commitment to various professional organizations. Ninety-two percent of participants are involved in national science organizations while 58% are involved in state/regional science teacher organizations. The APES teachers in this study reported membership in 27 different professional organizations.

Approximately two-thirds of the participants surveyed have received at least one professional award. School teacher of the year awards were received by one-third of the APES teachers, and national level awards were also received by one-third of the APES teachers.

These APES teachers also demonstrate a strong commitment to education by their involvement in several types of professional service. Over half of them have served as mentor teachers for one or more years and almost half have served as intern/student teacher supervisors for one or more years.

The APES teacher participants surveyed also exhibited a strong commitment to the APES Reading experience and openly expressed its value to them as a teacher. All but 7 of the 60 teachers in this study were veteran APES Reading participants. Clearly, APES Reading participants tend to return year after year. During the 18 interviews, those who had missed particular years since their first year as Reading participants indicated that they wanted to attend every year but were prohibited from doing so by administrators or schedule conflicts.

When probed about their perceptions of the role of teachers in the educational process, APES teachers expressed a philosophy of constructivist, student-centered education where students are actively engaged in their learning. The teacher is most often seen as a facilitator and guide, not as an expert in environmental science. Many of the participants surveyed and interviewed expressed a commitment to a variety of instructional techniques and to inquiry-based teaching and learning. Their commitment to inquiry-based learning was supported by their reported use of lab activities (98%) and discussion (93%) as components in their APES teaching.

CHAPTER 5

RESULTS OF RESEARCH QUESTION 2

This chapter addresses results relevant to Research Question 2: “For veteran teacher participants who view the Reading as a positive professional development experience, what aspects of the Reading do they perceive are most beneficial to them?” From surveys and interviews I attempted to compile features of the Reading participants deemed beneficial to them professionally.

Analysis of survey and interview results yielded two major themes related to the Reading as a positive professional development experience: the Reading process itself, and to a lesser extent, particular products they obtained as a result of participation in the Reading. Interestingly, survey participants’ responses predominantly focused on process benefits of the Reading. They reported the most important beneficial aspects of the Reading included discussions and interactions with their peers, the actual reading of student essays, and the sharing of content knowledge and pedagogical techniques. Though interview participants also reported that the process of the Reading was beneficial to them, their responses focused on actual outcomes or products they took away from the Reading experience. These products included new teaching resources, increased environmental science knowledge, pedagogical tips and techniques, more knowledge of test procedures, and specific personal benefits.

Because of the major differences identified in participants’ responding to the surveys and those participating in interviews, I analyzed findings regarding this research in two different parts. Part I focuses on the process-oriented benefits identified in survey

responses while Part II addresses product-oriented benefits identified during the interviews. (See Appendix D for a description of interview participants.) I recognize the possibility that, regarding this research question, survey responses being basically process-oriented and interview responses being basically product-oriented may be a reflection of the particular items included on the survey and the questions asked during the interview process.

Part I: Participant Survey Responses Regarding Beneficial Aspects of the Reading

Two survey items that addressed Research Question #2 were: “What aspects of the Reading do you find professionally rewarding?” and “Of the aspects you listed above, which ones do you find most professionally rewarding and why?” These questions were in a section of the survey that was completed by APES teachers who had participated in previous Readings. Fifty-three of the 60 survey respondents had participated in previous Readings and all 53 responded to the first of these questions, while 51 responded to the second question. Because all of the veteran APES Reading participants indicated there were professionally rewarding aspects of the Reading, responses from all of the veteran participants surveyed were considered in the results.

As indicated previously survey responses related to professionally rewarding aspects of the Reading centered on the actual process of the Reading. These benefits included discussions with peers, the actual reading of student essays, the sharing of ideas with peers, the grading process, attendance at Professional Night, and the friendships formed in the Reading process. When asked to rate which of these was most beneficial, they identified interactions and discussions with peers as most professionally rewarding.

Professionally Rewarding Aspects of the Reading

In response to the survey question: “What aspects of the Reading do you find professionally rewarding?” participants listed between zero and five responses. The average number of responses per participant was two.

The response listed by the most participants was discussion/interaction with peers (45). This was followed by rubric development/discussion (22), reading student essays (19), sharing teaching tips/labs (10), discovering student misconceptions (6), the grading process (6), Professional Night (5), and friendships (3). Table 5.1 summarizes responses to this survey question. Only responses reported by more than one participant are included in this table. Learning about environmental science issues/topics, seeing other United States biomes, refocusing and rethinking course goals, learning about ETS/College Board, and learning in other academic areas were beneficial aspects that were each reported by one participant.

Table 5.1 Aspects of the Reading Viewed as Professionally Rewarding by APES Reading Participants Surveyed (N = 53)

Aspect	Number of Participants
Discussion/Interactions with Peers	45
Rubric Development/Discussion	22
Reading Student Essays	19
Sharing Teaching Tips/Labs	10
Discovering Student Misconceptions	6
Grading Process	6
Professional Night	5
Friendships	3

Most Professionally Rewarding Aspects of the Reading

Fifty-one of the 53 veteran APES Reading participants responded to the question: “Of the aspects you listed above, which ones do you find most professionally rewarding and why?” Twenty-nine indicated discussion/interaction with peers was the most professionally rewarding. Others listed rubric development/discussion (11), the grading

process (9), reading student essays (8), sharing teaching tips/labs (6), and discovering student misconceptions (2) as the most professional rewarding aspects of the Reading (Table 5.2). Aspects reported as most important by one study participant each included professional night and learning in other academic areas. Fourteen participants surveyed listed more than one aspect as most rewarding and three indicated that they could not state what was most rewarding.

Table 5.2 Aspects of the Reading Viewed as Most Professionally Rewarding by APES Reading Participants Surveyed (N = 51)

Aspect	Number of Participants
Discussion/Interactions with Peer	29
Rubric Development/Discussion	11
Grading Process	9
Reading Student Essays	8
Sharing Teaching Tips/Labs	6
Discovering Student misconceptions	2

Sixteen of the APES teacher participants surveyed explained their responses to the item regarding most professionally rewarding aspects of the Reading. Eight focused on discussion/interaction with peers, four focused on reading student essays, two focused on rubric development/discussion, and two focused on the grading process.

In his response regarding why peer discussions/interactions were most professionally rewarding, Gerald wrote, “because I get new ideas for curriculum.” In response to peer discussions/interactions Sam wrote, “There is no other professional development opportunity that I have with public school teachers, private school teachers, and college professors for an extended period of time!” In her explanation of the importance of peer interactions/discussions, Allison wrote, “I get a more concrete picture of the environmental concepts that are involved in those questions.”

In her explanation of why reading essays was most professionally rewarding, Sandra wrote, “It helps me learn what the major misconceptions are to enable me to be a better teacher.” In response to this same area Marlene wrote, “It lets me see how to improve and angle my teaching.”

In his response to listing rubric development as most professionally rewarding, Roger wrote, “It gives me a much greater insight into what my students need to focus on in writing. It has helped me to be a better evaluator of my own tests in APES classes and my chemistry classes as well.” In his explanation on the rewarding aspects of rubric development/discussion, Charles wrote, “It gives me new ways to think about topics and insight into how students answer questions.” In her explanation of how the grading process is most professionally rewarding Pam wrote, “It helps me assess how well I am preparing my own students and how well I know the information!”

Summary of Participant Survey Responses Regarding Beneficial Aspects of the Reading

APES teacher participants surveyed clearly felt the Reading experience was beneficial to them professionally. The most valued aspect of the Reading identified by participants surveyed was the process of the Reading itself. This included opportunities for interactions with other Reading participants, the reading of student essays, and sharing of content knowledge and pedagogy with peers. Over half of the participants surveyed indicated these were the most professionally rewarding aspect of the Reading. Encouragement from other participants as they interacted throughout the course of the Reading was also viewed by some as an important part of the Reading process.

Study participants also reported that the Reading experience helped them identify what is expected of their students on the APES exam, understand how the Reading

process works, how scoring rubrics are designed, and how to better design and use rubrics themselves. These teachers also indicated that participation in the Reading helped them identify common student misconceptions and develop strategies to address these misconceptions. As a result of participation in the Reading process they also gained new ideas for labs, new assessment techniques, and new content knowledge.

On the survey, no negative comments about the professionally rewarding aspects of the Reading were provided. The fact that sixteen participants took the time to explain their responses to the two survey questions in this area underscores their views that participation in the APES Reading experience is professionally rewarding.

Part II: Participant Interview Responses Regarding Beneficial Aspects of the Reading

Eighteen veteran APES participants were interviewed. Though there was some overlap in beneficial aspects of the Reading reported by survey and interview respondents, the in-depth interviews allowed ideas to surface that did not come up in the two survey items related to this research question. Although interviewees mentioned interactions and discussions that occurred during the process of the Reading, their views regarding beneficial aspects of the Reading focused more on the products that resulted from the experience.

Insights regarding Research Question 2 came throughout the interviews, but they primarily occurred in response to the following interview questions: “What is it about the APES Reading that keeps you coming back?” “Is it important for APES teachers to participate in the Reading? Why or why not?” “What’s the best thing about the APES Reading? Why?” “Do you think the APES Reading meets any of the criteria (about

professional development) you identified in number 12? If so, which ones? How?” “How could the APES Reading be made more beneficial to the Readers?”

Seventeen of the eighteen reported that participation in the Reading was a positive professional development experience. Only one participant interviewed gave a negative response about the Reading as professional development. However, she then clarified that although the APES Reading did not provide planned, organized professional development, a lot of professional development occurred naturally as a part of the Reading process. Therefore, responses regarding beneficial aspects of the Reading are included for all 18 interview participants.

The 18 interview transcripts were read and reread several times to identify emerging themes. They were read with an eye to the research questions. Responses were grouped into the three areas corresponding to the three research questions. When I read a statement related to one of the research questions, I wrote that statement on a post-it note and attached it to the front of their transcript. I then grouped the statements related to each questions into larger categories or themes. I stopped rereading a transcript when I did not see ideas that were not noted previously.

Categories of responses were developed related to Research Question 2: “For veteran teacher participants who view the Reading as a positive professional development experience, what aspects of the Reading do they perceive are most beneficial to them?” Areas viewed as most beneficial were classified into five main categories: teaching resources, increase in environmental science knowledge, pedagogical tips and techniques, knowledge of test procedures, and personal benefits. Specific subcategories also emerged

in some of these main categories. The area of new teaching resources was mentioned by every interviewee and the subcategory of lab resources was perceived as the most beneficial area. They consistently shared how the Reading had increased their environmental science knowledge and gave them specific pedagogy and test techniques which they could employ in their classrooms. There were only eight of the eighteen that specifically spoke of the process of interacting with others as a benefit.

In addition to stating perceived benefits of the Reading, participants interviewed clearly defined professional development. They made general statements about the Reading as effective professional development and stressed that the professional development aspect of the Reading was one of the benefits of the Reading to them professionally and personally. Because of their emphasis on the Reading as effective professional development, a section stating their definitions of effective professional development and how the Reading was beneficial to them as professional development is included in this chapter.

The following sections present quotes from the 18 interviews that supported the benefits categories and subcategories that were developed. I clarify which questions are being answered in order to put the answers in context and illuminate the possibility the questions influenced a response.

Teaching Resources

All of the 18 participants interviewed made reference to the good, new teaching ideas they took home from the Reading. At first, they spoke of new ideas in general. This often occurred in response to the question: “What’s the best thing about the APES Reading?” Larry said, “The very good ideas that one can take home from this kind of place. That’s been very, very helpful.” Martin said, “There’s just so many good ideas

floating around.” Pam indicated, “You can just pick up all kinds of things, even over a causal dinner conversation.” Courtney stated, “After I leave the Reading here, I have new ideas.” Tom stated, “its professional camaraderie, its sharing of ideas.” Jane responded, “I also get a lot of ideas about how to do different things or approach different things as I talk to people.” Bob said,

And it’s important to come to get ideas because there are a lot of smart people here, who have really good ideas, who like what they’re doing and get a lot out of their kids and their kids get a lot out of them.

John stated that when an idea “is exchanged between two teachers, you know both of them are improved.” John summed up the importance of the Reading to him when he answered the question, “Is there anything else that’s really good professional development?” He said, “The process itself and the exchange between teachers is like a daily workshop that goes on as they are talking.”

David talked about how teacher interactions help in the grading process and understanding where to focus teaching when he answered the question, “What do you consider the best things about the Reading?” He said,

The best things are the perspective that you get on environmental science and on the students, the level of environmental science that is taught in the country, and how the students’ responses to the exam are important. The Reading gives you an understanding of where you fit in this comparatively.

During the course of the interviews, the participants provided more specific information about the good, new ideas they were exposed to. They specifically identified labs, new resources, applicable and useful knowledge, and networks.

Labs. The value of the Reading experience as a great source of new lab ideas was identified in 17 of the 18 interviews. Interview participants spoke of new labs, new lab techniques, help regarding what did and did not work in labs, and ways to improve or

change labs they already used. I asked Carl, “What’s the best thing to you about the APES Readings?” He referred to finding out, “what kind of lab you might do for water quality.” In answering this same interview question, Courtney referred to lab discussions with other Reading participants. She stated,

Okay, I want to do this lab, but it’s very different if somebody tells you well, here are the problems, you know? And normally what often happens is you have a lab that you find and you think that it’s going to be very effective, but then you do it and it doesn’t work. . . Whereas when someone tells of a lab, someone that has been doing it and tells you watch out for this, watch out for that or make sure that you get this or make sure that you don’t do this. Then you do the lab and it works.

Nine of the 18 interviewees talked about labs when they answered, “How could the APES Reading be made more beneficial to the readers?” They referred to previous years when participants brought copies of their favorite labs and shared them with the each other. Referring to the lab exchange, Denise said the “exchange in labs and everything helps a lot.” Larry said that it is “the best source of new laboratory material and new ideas anywhere.” There was not an organized lab share at the 2004 APES Reading.

When identifying ways the Reading would be more helpful, Anita stated, “the sharing of the labs and stuff, they haven’t done that either year that I was here.” Carl stated, “On my first year here we did a lab sharing thing. Teachers shared things that they brought. I thought that was important.” In reference to activities at this year’s Reading, Martin answered, “I missed the lab exchange, it was really worthwhile.” In underscoring the importance of lab sharing, Bob stated, “I don’t know about other disciplines, but a certain part of science teaching is sharing resources and ideas and labs and exercises and worksheets.”

New resources. Seven participants identified exposure to new resources in answer to the question: “What is it about the APES Reading that keeps you coming back?” Larry

referred to “having new resources that the teacher can utilize either directly with their classes or at least learn more that can be part of their class discussion.” Nancy talked about sharing “recommended books” and how this sharing is “really beneficial” to her. Martin made reference to a “story you can tell the kids you know, it personalizes learning and I think that’s a really big help.”

I asked, “What is it about the APES Reading that keeps you coming back?” Bart and Courtney referred to information they gained about the usefulness of various environmental science textbooks. Bart said “I never have someone at my school to talk to about APES, as basic as what textbook do you use, do you find that textbook a little too full of junk, a little too full of misconceptions or biased?” Kathy stated, “You make contact with people who are willing to review resources and then review them so that anyone looking for a textbook or video or lab manual or whatever now can find that resource again. . .” John said he was “introduced to a new website that I use.”

The speaker at the APES Reading Professional Night was also seen as a valuable resource for future use. I asked, “Do you think the APES Reading meets any of the criteria you gave for professional development?” Tom said, “I’ve used material from the man who spoke on radar birds a lot.” John stated, “every Professional Night, there’s something that we could take home.” I asked Carl the question, “What’s the best thing about the APES Reading?” He talked about the Professional Night being one of the best things at the Reading. He said,

As a teacher I don’t really get an opportunity to get to see those kinds of things very often and I think they are a good thing.” Participants also referenced the handouts, web addresses, and information given out at Professional Night.

Three interview participants referred to the time they saved because they were exposed to new resources during the Reading. I asked Bart the question, “What

experiences have helped you in reaching your vision of an effective science teacher?" He said

That thing that's so valuable to teachers that I wish I had more of is time. Like coming here and getting this high quality information that has been filtered through the experts across the nation. I'm literally saving myself prep time and looking for resources. It's invaluable in that sense

Networks. Six interview participants explained how they built resource networks of teachers as they were put into contact with each other at the Reading and maintained those contacts throughout the year. They reported that these teacher networks were especially helpful in the areas of environmental science knowledge, resources, and personal professional support. I asked the question, "What is it about the APES Reading that keeps you coming back?" Nancy stated, "I have learned a lot from, you know, networking here from the other teachers." Martin responded to the question, "Do you think it is important for APES teachers to participate in the Reading?" He said, "it's a network for you to learn from 140 really smart people, you know interesting people. I think that can't be beat. You can't get that anywhere else." In response to this same question, Denise talked about the advantage of the network of teachers at the Reading. She explained, "They take care of each other. Throughout the whole year you can hear from them. You say, 'Oh I'm having trouble with this or something, how did you do it?' and they'll tell me."

Carl responded to the question, "Does the APES Reading meet any of the criteria you listed for professional development?" He said this network of teachers enables you to, "have a conversation with 120 other people who teach APES. You can have some opportunities to change your focus on things and your perspectives."

Increase in Environmental Science Knowledge

All 18 participants interviewed referred to the fact that they greatly increased their environmental science knowledge during the process of the Reading. This increase in knowledge came from a variety of sources. Seventeen interview participants referred to their discussions with college professors and other teachers who had content knowledge in specific environmental science areas where the interview participants' own content knowledge was weak. Not only did they refer to increases in basic knowledge, but six interviewees also identified an increased ability to see connections among the various environmental science topics and concepts. Seven indicated the benefit they received interacting with teachers from many different regions of the country. Contact with these teachers enabled them to learn more about different environmental issues throughout the country and broadened their view and understanding of environmental issues.

Increase in knowledge base. All of the teachers interviewed referred to how the APES Reading helped them increase their knowledge of environmental science. They reported that this happens in a variety of ways. Kathy responded to the question, "What is it about the APES Reading that keeps you coming back?" She referenced conversations with professors and other teachers. She stated, "I just learn an incredible amount. There are concepts that I am maybe a little fuzzy on, that I can come here and really say 'Okay, now I get it, you know?'" I asked, "Is it important for APES teachers to attend the Reading?" Jane said there is "the building of my science knowledge." I asked Bob, "What is the best thing about the APES Reading to you?" He felt the Professional Nights increased his understanding of environmental science concepts. He stated, "It's a good way to learn about something you don't know much about."

David talked of learning and sharing knowledge with others when he answered the question, “What is the best thing about the APES Reading?” He said, “And I’ll go out after the Readings and I’ll identify plants and they’ll identify birds and you know we’ll kind of do some sharing back and forth in that way.” I asked Martin, “Is it important for APES teachers to participate in the Reading? What is the benefit to them?” He stated, “The people are great. They are just so interesting. They’ve done so many different things and have so many different experiences and know so much from so many different fields.” In response to this same interview question, David talked about the exposure to teachers from a variety of specialties. He said,

You get about 140 people down here and some of them have geology backgrounds, some of them have engineering backgrounds and some of them have botany backgrounds, some of them are population biologists, some of them are in education. . . from education backgrounds, zoology backgrounds. A lot of backgrounds to build the level of education in this country because I think education is certainly better off. . . Each person has a different area of knowledge and each contributes different information that increases the environmental knowledge of other participants.

Three interview participants referred to what they learned in the process of reading student essays. As they read essays, they discussed student answers and were exposed to information they may not have been aware of before the Reading. Nancy was asked, “What is it about the APES Reading that keeps you coming back each year?” She stated, “I always learn from whichever free-response question I’m on.” Bart responded to the question, “What is the best thing about the APES Reading?” He said,

I’ve been put on a question that I don’t know much about and it happens every time and it’s great, it’s one way to learn. And there’s somebody in that room that knows the details and the questions come up while I’m reading, I ask is this detail right? I’m the first one to admit, I don’t know it all and I’ll go to someone and they’ll teach me.

See more connections among environmental science topics. As teachers increased their environmental science knowledge and talked to participants from other regions, six participants reported that they began to see more connections among the various aspects of environmental science and felt better prepared to help their students see these connections. I asked Nancy the question, “Do you think the APES Reading meets any of the criteria you listed as important to professional development?” She talked about the importance of reading student essays. She said she is, “reminded of how concepts link.” In response to this same question, Kathy talked about now being better at helping students because she “started seeing those connections.”

Pam answered the question, “Has participation in the Reading influenced your teaching philosophy?” She stated that she has become more aware of connections in environmental science and the importance of these connections. It influences the way she sees the role of teacher. She stated, “When teaching I try to be more conscious of linking concepts.” Martin also talked about the value of seeing connections in environmental science when he responded to the question, “Is it important for APES teachers to participate in the Reading?” He said he, “evolves more and more in that direction, interconnecting things. . . also kind of broadening it up.” He stressed the importance of helping students see how interconnected environmental issues and topics really are when he said, “The more connections you can make, you know for the kids, the more they get out of it and the easier it is for them to appreciate what’s going on.”

Exposure to different geographic regions. For seven of the participants interviewed, the infusion of knowledge from different areas of the country increased their environmental science knowledge. Carl referred to his increased knowledge of

environmental science because he was from a different geographical region than where the Reading was held. He indicated there was value in being in a different region of the country when he answered the question, “Has participation in the Reading influenced your teaching philosophy?” He said, “It’s green here. It’s very green. We’re very brown. It’s a huge change in that regard so you can think of things a little differently.”

I asked David the question, “Is it important for APES teachers to participate in the Reading?” He responded by sharing the names of several participants and the very different environments in which they live and teach. He said, “to see the kinds of problems that other people have in a certain area. . . there’s different environments and there’s different ways that you teach the class based on that. You get a national perspective on environmental science.” I asked Kathy the question, “What is it about the APES Reading that keeps you coming back?” She said, because “coming to them helps to improve my knowledge of regional problems that I wasn’t aware of. . . it also enriches what you know about particular subjects.”

Interactions with teachers from different geographical regions not only increased environmental science knowledge about other regions of the country, it also provided participants’ with a broader, more global view of environmental science. Tom talked about the interaction with peers at the Reading in response to the question, “What factors have helped you in reaching your vision of an effective science teacher?” He stated, “The interaction with others here gives you a bigger world view outside your classroom, strengthens teaching inherently.” I asked Marlene, “What is it about the APES Reading that keeps you coming back?” She referred to how her interactions with other teachers at

the Reading gave her a much broader view of environmental science. She stated, “I’m more aware of how broad this topic of environmental science is.”

Pedagogical Tips and Techniques

Change in pedagogy was another recurring theme that emerged during the interviews. In this section I will discuss ideas that teachers shared about exposure to various pedagogical ideas and techniques. In Chapter 6, I will more specifically discuss changes in pedagogy that participants believe are a result of the Reading.

During the interviews, all 18 teachers referred to the effect of the Reading experience on their thinking about pedagogy. Kathy responded to the question, “Are there other things about the APES Reading that keep you coming back?” She stated, “This Reading definitely improves knowledge and also improves your pedagogy.” Specific comments related to pedagogy focused on five categories: understanding student misconceptions and how to deal with them, more effective approaches to teaching, teaching students to be better writers, reflection and critique of teaching, and ideas for using the AP test in their teaching.

Understanding Student Misconceptions. One benefit of the Reading identified by seven of the participants interviewed was that it helped them see student misconceptions more clearly. Jane talked about how the Reading helped her see the misconceptions held by students when she answered the question, “What is the best thing about the Reading?” She said, “I find I clear up a lot of misconceptions in my classes the following year. I change my unit a little bit to make sure they don’t have that same misconception next time around.” Bob also spoke of misconceptions when he answered the question, “What is it about the APES Reading that keeps you coming back?” He said, “The Reading helps me see what they are being taught and what they do not understand. It also helps see what

they're confusing." In her answer to this question, Marlene also said the process of the Reading helped her see student misconceptions. She said, "It helps you understand where the misconceptions are. If you see the same misconception in 20% of the papers, then there's a problem." In his answer to the question about what keeps him coming back, Carl said, "You see what misconceptions students have."

Teachers indicated that the Reading experience not only helped them see student misconceptions more clearly, but also stimulated them to try to find effective techniques for dealing with these misconceptions. This can be seen in Jane's response in the previous paragraph and in David's response when asked, "What is it about the APES Reading that keeps you coming back?" He referred to the value of reading student essays and stated, "I go back home every year knowing just exactly what misconceptions I'm not going to let continue. . . what misconceptions we're going to make sure, you know, aren't there any more."

I asked Marlene, "Has participation in the Reading influenced your general teaching philosophy?" In her answer she referred to student misconceptions and how important it is to be aware of misconceptions and correct them. She said, "I came to the Reading and I saw the problem of misconceptions. I knew these misconceptions had to be corrected." She explained she requires students to redo test questions they do not understand. She stated, "Then they have corrected the misconception. The only way that the right thing will get fixed is if it's redone."

More effective approaches to teaching. When interviewed, APES teachers were not always explicit about what they considered to be more effective approaches to

teaching, but were clear that the Reading helped them consider more effective approaches. This idea was mentioned by eight of the 18 teachers interviewed.

John explained the importance of discussions with other teachers at the Reading in his response to the question, “What else is there about the APES Reading that keeps you coming back each year?” He said, “The Reading is a great reminder of approaches that are really effective.” In response to the same question, David said, “The Reading makes a big difference in how you teach.” Bart spoke of his teaching in response to the question, “What do you think is the best thing about the Reading?” He said, “I’m probably a better teacher in some way. I’m going to be able to practice my profession better and I have a bigger brain sitting on top of that practice as well.” Also in response to the question dealing with the best thing about the Reading, Carl mentioned the importance of learning from other teachers to make his teaching better when he said,

There’s discussions that we have that I think will enhance my teaching, the sharing of what you do in the classroom, what things have worked for other teachers and what things might not work for me. I really think that’s really the biggest issue.

I asked Courtney the question, “What experiences have helped you reach your vision of what it means to be an effective science teacher?” She said, “You are able to grow both in methodologies, in techniques that we learned, in information and expertise from different fields, and in methods of evaluation.”

Kathy indicated that she has become a more effective teacher after participating in the Reading because she can help students become better at understanding important concepts and ideas. She responded to the question, “What is it about the APES Reading that keeps you coming back?” She stated, “You are not teaching to the test, but you’re going to sharpen your students’ ability to focus on ideas and just get more out of the course in general by being an APES Reader.” In response to this same question, Martin

indicated that participation in the Reading had made him a more effective teacher as he became clearer in his expectations of students and communicated more effectively. He said, “I think more critically about exactly what I ask and how I ask it, what I expect, what wording I use in a question you know, so that it brings out what the kid really, really knows.”

Teaching students to be better writers. Helping students become better writers was an expressed goal of five teachers interviewed. These participants expressed concern that today’s students are not good writers. One of the specific problems they mentioned in this area was students’ lack of ability to assess what questions are asking. John was asked, “What specific changes do you see in your teaching as a result of participating in the Reading?” He talked about the problem of students not reading and writing well when he stated, “You know, they think they are really responding to what’s asked. They miss the approach that the questions are really getting at. They do not answer questions well because they do not read the questions correctly.” I asked Denise, “Have you made any specific changes in your teaching after attending the Reading?” She stated that “learning how to teach writing skills is important.” She viewed it as important because,

I really feel like we have lost something in the last 20 years and we’ve lost the skill and that skill is writing. How do you get it out in public or let’s say in the ‘real world’ and not be able to write?

Bob shared a view opposed to that of John and Denise when he answered the question, “What is it about the APES Reading that keeps you coming back?” He said the Reading was an encouragement to him as he saw,

The quality of the writing has gotten better over the past seven years. We were talking about that today. They’re just better at answering the questions and that’s from people coming from the Reading and either going back to their kids or going back to their workshops and saying this is how you have to teach kids how to approach questions.

I asked Carl, “What else has changed in your teaching as a result of coming to the Reading?” Carl also stated his positive view of students’ writing and the influence of the Reading on his other science classes. He said,

My ability to help students write better is not just in my APES classes, but in all my classes. As I come here and read the free response on the essay questions, I think it’s made me a better writer and teacher of writing in science classes. . . not just in APES class, but in my other science classes.

Three interview participants specifically explained how they have learned to help students become better writers as they required students to become more specific and clearer in their answers to essay questions. Bart referred to his increased understanding of the importance of writing in his response to, “What is it about the Reading that keeps you coming back?” He stated,

I’m not going to infer anything. . . because I now see. . . it has to be communicated through words that the kids completely can connect the issue with the detail and then show that they understand this deeper. . . That’s probably just a better way to teach anyway.

Kathy explained how she has changed the way she grades student writing when she answered the question, “Has participation in the Reading influenced your teaching philosophy?” She talked about one way she has helped students become better writers. She stated,

I highlight everything that is extraneous so that when the student gets the paper back what jumps out at them is everything that they wrote that was non-essential. You’re not telling the kids what you wrote here is wrong, but it’s just that it’s either irrelevant or inappropriate for the question or doesn’t address the question. It also helps them to focus more on the question asked.

I asked Sue, “Has your teaching philosophy changed after attending the Reading?” She shared that participation in the Reading, “makes me a better reader of their writing and that way I can also teach them how to write better. If it is an argument based on fact you have to support yourself with reasonable things.”

Reflection and critique of teaching. Six teachers interviewed expressed the idea that the Reading provided an opportunity to reflect on and critique their teaching. They also reported that interactions with other APES teachers provided opportunities for input from teachers who teach the same subject. Marlene discussed the importance of interactions with other APES teachers at the Reading when she answered the question, “Do you think it is important for APES teachers to participate in the Reading?” She stated, “Normally in a school system you are the only person teaching APES. If you are trying to develop or talk about something new, this is the best place to talk and see whether you’re on-line or off the wall.” In response to this same question, Carl stated, “The Reading is an incredible and invaluable experience for those worried about themselves as a teacher and how they might approach teaching. . . what we teach and the validation issue.”

Teachers interviewed report that the Reading is an opportunity to look at one’s approach to teaching and an opportunity to validate that the approach is effective. Courtney shared that the Reading experience helps validate what she does as a teacher when she answered the question, “What is it about the APES Reading that keeps you coming back?” She stated the Reading was important to help her know, “I’m doing the right thing. I’m teaching the right thing. . . I’m teaching at the right level.”

Using the AP test in teaching. Four of the participants interviewed made direct reference to their use of the AP essay questions, published rubrics, and released multiple choice questions to help their students better understand environmental science concepts and test-taking techniques. I asked Kathy the question, “What do you consider to be important criteria of effective professional development?” She explained that the

professional development activity must be useful to teachers in their classrooms. In reference to the Reading experience she said, “We all use the released free response questions and walk them through the rubric and grade them. . . So it does help them with their time management and also helps them to focus more on the questions asked.” Anita also discussed her use of released exams and grading rubrics when she answered the question, “Are there specific things relative to participation in the Reading that have affected your assessment practices?” She explained that coming to the Reading enables her to help students understand how to read essay questions and write better responses. She stated, “I’m using more open response. . . I’m actually using those exams and I’m using the actual rubric to grade it by. .

Tom also talked about grading essays at the Reading when I asked, “What else is there about the APES Reading that keeps you coming back?” He stated that as students are exposed to AP free response questions and understand what is expected in answers to them, they become better readers and better writers. He said,

I do a much better job with the essays, with my essays with kids and teaching them to read an essay and truly answer it. That has very big carryover to the college aptitude test and the other parts of their life where they’re being compared on a nationally normed test or whatever.

Three interview participants referred to their use of the released AP multiple choice questions in their classroom teaching. Bob indicated that practice with different types of multiple choice questions aids in student learning. He discussed some of the ideas he picked up from the Reading when he answered the question, “What is it about the APES Reading that keeps you coming back each year?” He stated, “I use the multiple choice test as much for practice as anything else. Maybe improving testing ability is as much practice as it is evaluation.”

Even though the multiple choice part of the exam is not a part of the APES Reading, the Reading experience exposes participants to ways the released exam could be used in their APES teaching. Kathy discussed use of the AP test in her teaching and in the teaching of her colleagues when she answered the question, “Has participation in the Reading had any influence on your teaching philosophy?” She said, “We get ideas here on how to use released multiple choice exams. Some teachers incorporate them into their existing tests. . . I have used it as a pre-exam test. Some of them use them strictly as a review guide.” In addition to use of the multiple choice and essay portions of the test in their actual teaching, respondents discussed the actual grading process and its benefit to them in such great depth that it will be treated as a separate theme with several subcategories.

Knowledge of Test Procedures

Another theme that emerged from the interviews focused on increased knowledge regarding test procedures gained by Reading participants. All 18 of the participants referred to benefits related to knowledge of test procedures and ideas for testing that they received during the Reading process. They spoke of an increased ability to develop and use scoring rubrics and identified ways the Reading experience helped them better prepare their students for the APES exam and essay tests in general.

Rubric development and use. Nine participants interviewed made direct reference to the importance of rubric design and use in their own classroom. I asked John, “Is there anything else about the Reading that keeps you coming back?” He talked about the rubric development process and knowledge he gained about how to use rubrics, how consistently rubrics are applied at the APES Reading, and how they have helped him to be more consistent in his own grading. He stated,

Helping develop rubrics is a great experience. It is also very meaningful to me because application of the rubric in as consistent a fashion as humanly possible has helped me as a teacher back home be consistent in scoring my own essays and helped me be fair in treating one student just like another.

David referred to learning about the fairness and consistency with which the rubrics are developed and applied when he answered the question, “What’s the best thing about the APES Reading to you?” He stated,

You bring them all together to where they grade the same question in the same way. Sometimes people just love to complain in the introduction of the rubric process. It’s all part of this process of making it yours and becoming a part of it and buying into it. It really is fair and this all goes into making it fair, and I think that’s basic because I would never have believed that it could be.

I asked Kathy the question, “Is there anything else about the Reading that keeps you coming back?” She explained how rubric development and application made her a better teacher. She stated,

It forced you to focus and organize how you thought about a particular topic and how you could then present it. When the rubrics are done, you have a nice neat little lesson about a particular topic, so that enhanced my teaching when I went back. It also helped me to grade my own essays. It sharpened my skills in making rubrics so I felt I grew as a teacher as well.

Student preparation for test/essays. Ten of the participants interviewed made direct reference to how the Reading helped them prepare students for the APES exam, especially for the free response questions. Participants explained that participation in the Reading helped them understand the level of specificity that must be included when students answer test questions. Allison reported how the Reading experience made her a better teacher as part of her response to the question, “What is it about the APES Reading that keep you coming back year after year?” She said,

Each time I come back I seem to learn something more, some additional thing that can help my students, especially on the free response. Coming back every summer reinforces how specific, and not only how specific, but where to be specific, and that’s very helpful.

John explained another way rubric development and application were useful to him when he answered the question, “Is it really important for APES teachers to participate in the Reading?” He stated,

Going through the mechanics of a rubric and applying it, you see it’s fairly common for students to not be as thorough as they should. So to really have that reminder that you must finish the thought, be as specific as you can be.

Sue talked about the process of grading essays when she answered, “What do you see about the APES Reading in terms of meeting the criteria you just talked about?” She said, “They have taught me a new way to grade again. They helped me see through the words to see the meat of what students are trying to say. It helps me to help my kids to do even better.” Allison talked about her experience at the first APES Reading when she answered the question, “How do the tests themselves help you evaluate your teaching?” She stated,

After coming to this Reading the very first time is when I realized, “Wow, how exact kids have to be and how what they think in explaining something is usually so vague.” I have to help them be very specific in what they write.

Personal Benefits

In addition to all of the ways the Reading was beneficial to the Readers professionally, 13 of the 18 participants interviewed added comments about what the Readings meant to them personally. Kathy talked of personal benefits when she answered the question, “What is the best thing about the Reading to you?” She replied, “I think you have to look at it holistically and say, ‘I have been enriched personally and I have been enriched professionally because of all of these components.’” In speaking of personal benefits, the Readers included the areas of camaraderie/interactions, rejuvenation, and increase in self-esteem. Though participants interviewed did not always relate these areas

to their pedagogical practice, any personal benefits they received from participation in the Readings have the potential to improve their pedagogy.

Camaraderie/interactions. Eight of the participants interviewed talked of the importance of camaraderie and interactions with other teachers. I asked Jane the question, “What is it about the Reading that keeps you coming back?” She responded, “It’s the interaction with the people. I’ve known some of these people now for 11 years. It’s certainly much more work for me to be here, our school is not out yet so it’s double prep.” In response to this same question, Allison also talked about the interactions. She said,

I like coming back because I like the interactions with other people. There’s nothing else really during the rest of the year for me to do that. Until this year, I was the only AP teacher in our county for environmental science.

Nancy talked about the importance of interactions with others in her answer to the question, “What else is it about the Reading that is important to you?” She said, “There’s that wonderful rapport, camaraderie which, you know, if you felt that you were the only APES teacher on your side of town, you just don’t have that at the Reading.” Martin talked about interactions when he answered the question, “Do you think it’s important for APES teachers to come to the Reading?” He said, “I think the part of the Reading that’s really valuable is the interaction with people.”

Rejuvenation. Five of the participants interviewed referred to the rejuvenation, inspiration, and energy boost they received from participating in the APES Reading. Larry spoke of the positive personal benefits when he answered the question, “Are there any other factors that come to mind that have really impacted you in the positive?” He answered, “the inspiration and the energy I get in this place.” He also said, “What comes back is getting the renewed energy and spirit and confidence that AP is a great course. . .

just having good friends and colleagues who during the course of the year you can email.” Bart also spoke of the rejuvenation benefit of the Reading when he answered the question, “What is moving you toward this vision of an effective science teacher?” He stated, “It reenergizes you.”

Denise spoke of renewal when I asked, “What keeps you coming back to the Reading?” She answered, “It was like the next year I’d go back and renew myself. It was like renewing yourself through friendship and renewing yourself through how you taught.” In her answer to this question, Courtney said, “It’s like a vitamin boost every time.” John also spoke of renewal when he answered, “What is the best thing about the Reading?” He said, “It’s rejuvenating, doubly rejuvenating.”

Increase in self-esteem. Three of the 18 participants interviewed explained that the Reading positively influenced their self-esteem. Nancy spoke of increased self-esteem when she answered, “What is it about the Reading that keeps you coming back?” She said, “Coming to the Reading is really a boost of self-esteem. I feel support from you and everyone. I believe it’s an honor to be asked back and to be a participant.” David also talked about an increased sense of self worth in his answer to, “What is the best thing about the Reading?” He said, “I think all the readers rather enjoy it. They feel very accomplished. When you finish up you really feel like you’ve done something.”

Bart talked about self-esteem benefits of the Reading when he answered, “What is moving you toward this vision of an effective science teacher?” He stated,

There are a lot of great teachers out there having a hard time teaching the same concept I am. Its good to know we all have our shortcomings in this large general subject called environmental science. You can be a jack of all trades, but master of a few things. So I go back feeling like, “Okay, I’m alright.”

Effective Professional Development

All 18 participants explained their criteria of effective professional development. Eleven of the 18 participants interviewed also reported positively about the Reading as professional development.

Definitions of effective professional development. In order to understand how the interviewees view professional development as a benefit of the Reading, I felt it was important to understand how they were defining professional development and how their definitions related to the Reading. All 18 participants interviewed explained what they perceived to be effective professional development. They reported the following criteria of effective professional development: applicable/relevant/useful in the classroom (9), increase content knowledge (7), provide new ideas (7), improve pedagogical techniques (6), and engage participants (1).

Nine of the 18 participants interviewed reported that effective professional development is applicable, relevant, and useful in the classroom. I asked John, “What do you see as criteria of effective professional development?” He responded, “Something that is pertinent, relevant, and useful to you and to your students in class. It is something that you are going to use. If you can’t apply it, then it may be of limited value.” In answer to this question, Bart said, “It’s applicable and works in the classroom.” In answer to this question, Denise said, “It is something I can use in my classroom. Something I can bring back to the student that helps them.” Pam responded, “It’s useful, relevant, something that’s not a waste of my time

Seven of the eighteen participants interviewed reported that effective professional development increases content knowledge of participants. When asked about criteria of effective development, Larry replied, “The criteria is improvement in the teacher’s

techniques and knowledge.” Jane answered this question by saying, “Interaction with people to get different ideas and increase your knowledge base, both personally and for classroom application.” Kathy also stated her criteria of effective professional development, “I think professional development is two pronged: part of it is improving your knowledge in your subject matter and part of it is the how to of pedagogy.”

Seven of the eighteen participants interviewed reported that effective professional development provides new ideas. Two of these spoke specifically of new lab ideas. In giving her criteria for effective professional development, Nancy said, “You come away with a couple of new ideas or at least seeds of things that you can do.” Larry replied, “Professional development entails a couple of things. It is being able to have a good inter-relationship among people. It is also opportunities to learn and allow people to exchange ideas.”

Six of the participants interviewed reported that effective professional development improves pedagogical techniques. In defining effective professional development, David said, “It involves things that will make me grow as a teacher. It deals with some teaching techniques and helps make you a better teacher.” Bob also explained his view of effective professional development. He said, “It should move the teacher to be a better teacher. It should inform your practice.”

One participant interviewed (Jane) reported that effective professional development must engage the participant. She said, “I think it’s the same way as you do in your classroom. You have to engage the people, not just stand up there and lecture to them.

The Reading as effective professional development. Eleven of the eighteen participants interviewed spoke about the professional development aspect of the Reading.

John spoke of professional development when he answered the question, “What has kept you coming back year after year?” He said, “The professional development is always outstanding. I think it’s difficult to say if this is by far the best professional development that an APES teacher can have, but it is certainly in the running.” In response to the same question, Marlene replied, “It’s very good professional development because you get a change to interact with a lot of people.” Also, in response to the same question, David said, “I think it’s the professional development end of it. It has really made me grow as a teacher and as a professional.”

I asked Nancy the question, “What is the very best thing about the APES Reading?” She said, “The best I think is just that it is good professional development.” Bart also spoke of professional development when he answered the question, “What are some things moving you toward this vision of an effective science teacher?” He said, “Any kind of professional development that I’ve done with AP like this. It clearly has its usefulness to me.”

I asked Kathy the question, “What else is beneficial to Readers attending the Reading? Why should they attend?” She replied, “The pool of leaders here is going to impact the professional development of teachers who have not been able to come here, but are the result of the ripple effects of the contacts and ideas that come out of this Reading.” In answer to the same question, Carl replied, “It’s one of the best professional development opportunities I’ve ever done. It’s as good as any week long conference I’ve ever been to.” In response to this same question, Martin said, “The professional development is priceless. You can’t get anything more than that, no matter where you go. I mean you can’t do it.”

Two participants interviewed reported that their principals view the Reading as effective professional development. I asked Bart the question, “What do you see as effective professional development?” He said, “Here the Reading is just so focused and refined that my principal says ‘It is worth it. I know you come back better.’ He believes it is good professional development.”

Summary of Interview Responses Regarding Beneficial Aspects of the Reading

All 18 of the participants interviewed reported the Reading was beneficial to them professionally, especially due to the various products they were able to take away from the Reading. The products were teaching resources, an increase in environmental science knowledge, pedagogical tips and techniques, and increased knowledge of test procedures. They not only identified general areas of benefit, but they were also able to identify very specific methods and situations in which the Reading was beneficial to them. They spoke of particular labs, and resources they have incorporated in their teaching.

All 18 of the participants interviewed also spoke of the benefits associated with an increase in their environmental science knowledge. They referred to the increase in their environmental science knowledge base, new connections they now saw among various topics in environmental science, and increased understanding of environmental issues from other areas of the country.

All 18 participants also referred to pedagogical tips and techniques they received as a result of participation in the Reading. These tips and techniques included an increased understanding of student misconceptions and how to address those misconceptions, new methods of evaluation, techniques for teaching students to be better writers, ideas for promoting more reflection on and critique of their teaching, and more effective ways to use the AP test in their classes.

All 18 of the participants interviewed also reported an increased knowledge regarding test procedures. This included a better understanding of rubric development and use and techniques for preparing students for essay tests and the APES free response questions.

Regarding the Reading process itself, 13 of the participants interviewed spoke of personal benefits that occurred during the Reading. These benefits included camaraderie, rejuvenation, and an increase in self-esteem. Participants also expressed a need to reinstitute a more formalized method of sharing teaching ideas and techniques during the process of the Reading. All of the participants interviewed that had been at a previous Reading where formalized methods of exchange took place wanted them reinstated. Participants interviewed who were not at the Reading during those years heard about the process and wanted it to become a part of the next Reading.

Eleven participants specifically mentioned that the Reading was a professional development experience for them and all 18 interviewees stated ways they perceived the Reading was beneficial to them professionally.

CHAPTER 6 RESULTS OF RESEARCH QUESTION 3

This chapter addressed results relevant to Research Question 3: “For veteran teacher participants who view the Readings as a positive professional development experience, how do they report their professional practice has changed as a result of participation in the Reading?” Results related to this question will be presented in two parts. Part I focused on relevant responses from the survey (Appendix B), while Part II reported findings obtained from interview transcripts (Interview Protocol Appendix C, Participant Descriptions Appendix D).

The rationale for presenting survey and interview participant results separately is based on the priority each group gave the categories and the desire to carefully clarify how the categories were obtained and supported. Both survey and interview participants reported practice change in the categories of assessment, curriculum, instructional techniques, and labs. However, the priority of each of these categories was different with each group. Survey participants reported instructional techniques as their top category of practice change followed by assessment. Interview participants reported assessment and curriculum as tied for the top categories of change followed by labs.

Part I: Participant Survey Responses Regarding Changes in Professional Practice

Items 16 and 17 on the survey addressed Research Question 3. These two questions were in a section of the survey that was completed by the 53 participants who had attended previous Readings. All 53 veteran teacher participants surveyed responded to the first question and 52 of the 53 responded to the second question.

Fifty-one of the 53 veteran teacher participants indicated that their professional practice had changed as a result of participation in the APES Reading when they responded to item 16. One of the two who indicated that her professional practice had not changed (Sherry) added this comment: “The Reading has affirmed my current professional practice.”

I typed all of the comments written in response to item 16 in an Excel spreadsheet, grouped similar responses and then tallied the number of responses in each group. In this section I quoted comments in each group to support each category and clarify how the categories were defined. Only one of the 51 participants who reported a change in their professional practice did not list any specific changes. Other positive responders identified between one and four ways in which their professional practice had changed. Twenty-six listed one response and one listed four responses. The changes in professional practice listed were sorted into four categories. These categories and the number of participants reporting change in each category are summarized in Table 6.1.

Table 6.1 Changes in Professional Practice Reported by APES Veteran Reading Participants Surveyed (N = 51)

Category	Number of Participants
Instructional Techniques	33
Assessment	26
Lab Activities	11
Curriculum	4

Examples of specific written comments regarding practice change reported for each category are included in the following sections. The written comments are from participants who were not interviewed because written survey comments tended to be repeated and elaborated on by participants as they were interviewed. The interview participants comments are covered in the second part of this chapter.

Instructional Techniques

Thirty three of the 51 survey participant comments related to practice change focused on instructional techniques. Though the majority of survey participants referred to changes in instructional practice in a positive way, they usually did not clarify what those changes were. Lisa commented, “I have completely revamped the way I taught my course to better prepare my students.” Glen pointed out several areas in which the Reading had changed his instruction. He wrote, “The Readers are a rich source of information from classroom content to practices. It has also helped me help students become better writers.” Charles responded, “I came up with new ways of teaching them how to think, write, and argue more critically.” Carolyn wrote that a new instructional technique for her was to “more formally use old AP questions to help students read a question as it is written and not as they might interpret it.”

Cade and Paul wrote of including new instructional techniques into their teaching practice. Cade wrote about “incorporating these new ideas into my lesson.” Paul noted the “pick up of new ideas and activities.” Albert responded, “As a result of the Reading, I have tried many different approaches to teaching the APES course.” Tara wrote, “I came back and taught APES much more rigorously. As the course has developed it has become necessary to work more on free-response type questions.”

Assessment

Over half of the participants providing comments spoke of changes in methods of assessment they used in their APES classes. For example, Carrie wrote, “I grade more strictly on essays.” Nathan responded, “My test grading style.” Beverly wrote, “better/more consistent grading.” Morrie wrote, “I include more essay writing/rubric discussion in my instruction.” Marvin wrote, “After last summer’s Reading, I knew I

would completely change the manner in which I write and grade free response questions on the tests throughout this academic year.” Charles wrote, “I still test them traditionally, but I’ve added new ways.”

Eighteen of the comments related to assessment referred to increased teacher skills for preparing students for the APES exam. Sandra wrote that she was “better able to prepare students for the mechanics of the test.” Gary wrote, “I have been able to focus my effort to prepare my students better for the exam with specific hints on how to answer the free-response questions.” Russell simply wrote, “my preparation for the APES exam.” Sharon wrote, “I now, more than ever, teach my students the skills necessary to be successful in answering free-response questions.” Christine noted, “The only thing that has changed is how I prepare the students for the free-response section of the test.” Ken wrote, “It helps me better prepare the students for the free response question part of the exam.”

Gerald responded with confidence about being less subjective in assessment when he wrote, “I felt more confident and empowered when debating with students, their parents, or my administration about the grade I gave a particular student. It is very difficult for them to argue with me about my grading being subjective anymore.” Tara referred to increased confidence and ability to use a rubric when she wrote, “I usually assign students questions I’ve graded. When I nail them on their answers, it is with confidence that I’m following the rubric.”

Shirley and Sam wrote, “I know better how to prepare my students for the exam.” Sam also added, “especially the essay part.” Pauline referred to a new instructional technique in exam preparation, “I have my students grade their papers the same way we

do here. Many finally learn to be concise and several learn to read and answer the question they are asked.” Linda wrote, “My approach to teaching students how to answer essay questions has changed due to the way we grade here.” Rachel also dealt with an instructional technique and a change in assessment when she wrote, “I give more essays and have students use a rubric to grade the essays. I also backgrade them and we compare our scores.” Mary wrote, “I got my students to do a lot more writing of sample free responses. I also point out to students what people commonly do wrong on the AP exams regarding specific topics, like getting abiotic and biotic mixed up.”

Lab Activities

Eleven of the 51 survey participants reporting a change in teaching practice identified changes in their lab practices as a result of participation in the APES Reading. The main foci of their survey comments were: new lab ideas (6), lab design (3), and more labs (2). Sandra referred to new lab ideas when she wrote, “I have learned about new activities, labs, and resources I now use in the classroom.” Merv responded, “The labs and ideas exchanged have added depth to my course.” Patricia shared her inclusion of new labs when she wrote of “lab ideas from my fellow teachers.”

Ginny responded about lab design when she wrote, “I have learned to focus on teaching students how to design experiments.” Harvey referred to using more labs when he wrote that he did “more lab work.”

Curriculum

Four participants surveyed talked about practice change that affected their environmental science curriculum. The survey comments provided by respondents indicate that they changed their curriculum, but did not explain how a change in professional practice corresponded with this curriculum change. They reported an

increase in their expectations of students and changes in topics they stressed during the course of the year. They did not, however, identify examples of specific changes in expectations or topics. Helen responded that the Reading, “Made me raise my standards/expectations for students.” Jennifer wrote, “I feel more confident in what to teach, what to emphasize, what is important.” Merv responded, “The APES Reading gives me a ‘feel’ for topics and a different approach in teaching APES.”

Part II: Participant Interview Responses Regarding Changes in Professional Practice

All 18 interviewees reported multiple perceived changes in their professional practice as a result of participation in the APES Reading. Though there were some similarities between changes in professional practice reported in the surveys and the interviews, the interview participants added more depth to their responses and focused on some areas of professional practice that were not addressed in the survey comments.

As I read and reread the transcripts from the interview participants, I listed comments about changes in practice on a post-it note and placed the note on the front of each transcript. I then typed all the comments into an Excel spreadsheet, looked for comments that could be grouped, grouped them into categories, and tallied the number of interviewees responding in each of the categories. I identified five major categories of perceived change in practice. Interviewees spoke of changes in assessment techniques, curriculum covered, labs used, variety and types of instructional techniques used, and increased ability to help students with writing skills. These categories and the number of respondents in each category are summarized in Table 6.2.

Though changes in professional practice were reported throughout the interviews, they were mainly mentioned in response interview questions related to the “Impact of the

APES Reading on your teaching” section and to probing questions that evolved in response to interviewee comments in this section. This section of the interview included the following interview questions: “Has participation in the Reading influenced your teaching philosophy? In what way(s)?” “Are there specific changes you have made in your teaching as a result of participation in the APES Reading? If so, what is an example of that change?” “Has participation in the APES Reading caused you to rethink your ideas about important environmental science concepts that students should learn? Tell me about this.” “Has your participation in APES Reading influenced your assessment practices? If so, in what ways? If not, why not?” Interviewee responses to questions are included in an attempt to support and clarify categories.

Table 6.2 Changes in Professional Practice Reported by APES Reading Participants Interviewed (N = 18)

Category	Number of Participants
Assessment	16
Curriculum	16
Labs	14
Other Instructional Techniques	12
Writing Skills	11

Ten of the 18 participants interviewed gave a general response about their perceived change in practice that is not included in the categories listed above. John and Pam referred to the Reading as making them “better teachers.” Five Readers said that they have changed their approach to teaching. For example, I asked Bob, “Share some factors or experiences that lead you towards your view of an effective science teacher.” He replied “Coming to the Reading changes a lot of what I do.” I asked David the question, “Has it changed your educational philosophy?” He spoke of practice change instead of philosophy when he said, “No, but it’s changed, impacted the way I teach. I

think I do a better job as a result of this.” Denise gave a general response to the question “Have you changed some of your actual teaching practices as a result of coming to the APES Reading?” She said, “The last few years I have really changed my practices as I have learned from the Reading.” In response to the same question, Pam also replied, “I’ve changed my teaching practices because I’ve learned from the Reading.”

Two respondents indicated they were more focused and organized as teachers after attending the Reading. In response to the question, “Has the Reading influenced your teaching philosophy, educational philosophy?” Nancy talked of changes in her professional practice. She stated, “It has forced me to be much more organized. It forces me by the end of June to give everybody for the next year their summer reading and expectations and then we start the first week of class.” In response to this same question Martin also spoke of professional practice changes. He said, “I don’t know if it’s changed my philosophy, but I think it has changed my thinking. I’m more critical of all that students do.”

Assessment

Sixteen participants interviewed identified changes in their assessment practices as a result of attending the APES Reading. The assessment areas mentioned most frequently by participants were: free response/essays, rubric use or development, and testing frequency. General comments about becoming more stringent graders were made by two participants. I asked Nancy, “Do you feel like the Reading has influenced your teaching philosophy, your educational philosophy?” She responded, “I really expect more of the students and I grade them harder.”

Free response/essays. Fifteen participants talked about how they grade essays differently, use more essays, and give different types of essays as a result of attending the

APES Reading. Nine participants explained how the Reading experience influenced how they grade essays. Bart explained how he grades essays differently when he answered the question, “What changes in practices have you made as you attended the APES Reading?” He replied, “I look at the essay with a microscope. I’m not going to infer anything. Everything needs to be there written and spelled out. I do not fill in any blanks for my students.” In response to the same question, Larry responded, “The Reading not only gives me a tremendous amount of material for my essays, but it also makes me a better essay grader.” Tom also identified changes in the way he grades essays when he spoke of how he helps students with essays. I asked him, “Has coming to the Reading influenced your assessment practices?” He responded, “I have them underline the verbiage, underline the syntax of the question as it’s written because the questions are very specific. List, describe, explain mean different things.”

Five participants spoke of increased essay use during testing. Larry responded to the question, “Have there been changes in the way you assess your students after coming to the Reading?” He talked about increased essay use when he replied,

Now I really accentuate essays. I get them to write an essay with every test. Some of them are very short, but I tell them at the beginning that there’s going to be a lot of essay writing because that is how you communicate ideas. Not only does the Reading help me include more materials and give a tremendous amount of material for my essays, it also makes me a better essay grader.

Denise answered the question, “Has your participation in the Reading directly influenced or in some way changed your assessment practices?” She spoke of adding essay questions when she stated, “I did not give essay questions. They take too much time to grade. Now because of the Reading, I go back and make sure that I have essay questions on every test. I have open response questions.”

Three participants interviewed talked of giving different types of essays. I asked David, “If you made changes in your APES teaching, what changes did you make?”

David responded with changes he had made after attending the Reading when he stated,

We do more with assessments in the AP style and we do some preparation for the AP exam as well. We need to prepare them for it and so I prepare them for it in the styles they do it. Before coming to the Reading I would use a lot of essay questions, but they might be more particular. Now they are more generally worded and I put them in the same format they do in AP. I do a lot more multi-part questions like the free response style questions.

Rubric use or development. Ten participants made direct reference to rubric use or development in their comments about changes in their assessment practices. Eight participants interviewed spoke of using rubrics more and discussed how the use of rubrics helped them grade essays. I asked John the question, “What’s the best thing about the Reading for you?” He spoke of rubrics when he responded,

The application of the rubric in as consistent a fashion as humanly possible and knowing the hours and hours that went into the rubric prior to people ever arriving here. I have become more consistent in scoring my own essays. The rubric and the application of it is certainly a reminder of being consistent.

I asked Tom, “Are there specific changes you have made in any of your teaching practices after attending the APES Reading?” He also talked of rubric use when he responded, “I have a more systematic approach to essays and rubrics.”

Three of the above participants also spoke of never having used rubrics for grading before coming to the Reading. I asked Bob “Tell me a little bit about how you assess your teaching?” He talked of now using rubrics in grading essays when he replied, “When I use a rubric, which is something I never did before the APES Reading. . .” I asked Courtney, “Can you think of some specific teaching practices that have changed as a result of participation here?” She also referred to rubric use when she said,

Prior to coming here I had never used a rubric to grade and evaluate my own students. Now I seldom assign an essay that I don't do that. I also teach my students to use my rubric and show them how they were graded.

Three participants spoke of having learned how to develop rubrics, or create better rubrics, at the APES Reading. I asked Pam, "What about specific changes in teaching as a result of participation in the Reading?" She talked about rubric development when she replied, "I've learned how to develop a rubric before I do a test. I'm willing to accept X, Y, and Z and not A and B. I don't vary from that so the grading is fair for everybody." Kathy spoke of rubric development in response to the question, "About your assessment practices, has participation in the APES Reading changed some of them?" She replied, "I make better rubrics for my essay questions."

Testing frequency. Three participants referred to some type of change in how often they gave tests. I asked Jane, "I asked you about teaching changes, what kinds of assessments do you do in class to evaluate your students learning?" She responded.

That's one of the things that I have changed from coming to the Reading. I used to do an every chapter or every other chapter test. Now I just test in units so the kids get used to taking tests in much larger blocks. I am kind of weaning them away from that weekly test kind of thing. Because after all, this is a college class. It is just held in high school.

Curriculum

Sixteen participants interviewed referred to changes in their APES curriculum as a result of attending the Reading. These changes included: concepts/topics covered and the connections between various topics and concepts.

Concepts/topics covered. Eleven of the participants interviewed referred to changing their focus on topics, broadening topics, covering topics in more depth, and being more flexible in coverage of topics. Anita responded to the question, "Are there any specific changes you can say are a result of participating in an APES Reading as far

as your teaching goes?” In her response she talked about increasing her focus on the topic of soils. She said, “It’s changed some of the topics and it’s probably led to more prepping them for the exam than necessarily the topics. But I think I’m going to hit soils more next year because of the question I’m reading now.

Larry spoke of a change of focus on topics covered when he answered the question, “Has participation in the Reading influenced your teaching philosophy?” He stated,

It’s also helped me to focus on what the important topics are to teach. I think in terms of just what am I going to cover, what am I not going to cover, what am I going to leave out? Through the course of being here, I’ve really been able to kind of pull out what the important things are.

I asked Courtney, “Has participation in the Reading changed what you think are the important concepts?” She responded,

It certainly has made me cover more concepts. Very often as a teacher you tend to concentrate in areas that whether it is that you feel comfortable with them or because that’s what you like or what you want to make sure the students learn. Whereas having come to the Reading and having met with so many people who realize that all the areas are important. Not just a few. Soil was something that I didn’t think was that important. After dealing with some of my colleagues here I realize the importance of different kinds of soil and the composition of those soils.

Six of the participants spoke of including lessons and topics that they had not incorporated previously. David responded to the question, “You say the Reading has changed some of what you do. What are some examples?” He focused on the inclusion of new topics when he replied,

I cover some things that I didn’t cover before and I’ve increased the number of things that I cover and probably have broadened the course somewhat. I’ve also broadened the number of topics and coverage on some of the topics that I used to leave pretty much up to the text.

Martin was asked, “Have any other practices come to mind that you’ve changed?” He responded “I’ve rearranged topics. I also try to become more biological in some of the things I do. I also kind of broaden things I cover.” I asked Bart, “Has your participation in

the Reading helped you to re-think what you see as the important environmental concepts out there?” He replied,

Yes, there’s lots of breadth to the subject, so many things to know. It’s definitely helped me refine or at least prioritize what are the most important topics. I used to spend a lot of time on things that I liked or knew about. It’s very comforting to teach stuff you know about and skip the stuff you don’t. Re-defining what needs to be taught is relieving because it gives you time to do other areas.

Connections between various topics and concepts. Five of the 18 participants interviewed referred to seeing new connections between topics, giving greater emphasis to connections, and teaching those connections to their students. I asked Bart, “What changes in practices have you made after attending the Reading. Are there some specific things?” He responded, “Kids give answers that they really don’t connect themselves. I see now through the Readers that it has to be communicated through words that the kids completely can connect issues and details and then show that they understand things deeper. I require them to explain themselves in a deeper way.” In her answer to the same question, Kathy replied, “It gives more succinct ways of teaching concepts and how they’re connected with other ideas.”

Martin referred to connections among topics when I asked, “Have you changed any of your thinking on what’s important to teach as a result of being here?” He stated,

I try to be into the soils, the geology and the climate and all. They’re all related. Obviously you know that but we don’t just say today we’ll talk about the climate chapter because the soils also determine what lives there. I have evolved more and more in that direction, interconnecting things.

In response to this same question, Pam also responded that she helped students make more connections among environmental science concepts. She said,

I try to be more conscious of linking concepts. Well if this happens, then what is the implication of that, and then where do we go with that? We were big this year on brainstorming where a kid would shout out an idea and I’d draw an arrow on the

board and kids would just shout out things and we ended up with a web showing how complex and linked issues can get.

Labs

The use of more or new lab activities was the third most common change in professional practice mentioned in the interviews. Fourteen of the 18 interviewees made some reference to increased lab use, new labs, and redesigning labs.

Increased lab use. Five interviewees spoke specifically of using more labs in their classrooms. Jane discussed using more labs in her answer to “Is there anything else in terms of practice change in your classroom?” She replied, “As far as laboratory practices, I include more than I would have ordinarily.” Larry referred to more lab work and new labs in his response to the question, “Has participation in the Reading influenced your teaching philosophy?” He stated, “Yes I say it has. I give more opportunity for lab work because I have more opportunities to pick up new labs. A couple of years ago I developed a lab based on a conversation one night here.”

Carl referred to increased lab use in his response to the question, “Are there any other practices that you think have changed as a result of the APES Reading?” He replied, “The types of labs I do has changed because I’ve gotten a lot of lab ideas from talking to people here. Also, the percentage of time spent in labs each week has changed. I do more labs than when I first started.” Denise and Nancy also referred to labs in their response to the question, “What about actual teaching practices as a result of coming to APES Reading? Have you changed some of those?” They both stated. “I do more labs.”

New labs. Four participants interviewed stated they use new labs obtained from other participants at the Reading. In addition to the comments above made by Larry and Carl in this area, Pam and Courtney also spoke of incorporating new labs in their classes

when I asked the question, “What about specific changes in teaching as a result of participation in the Reading?” Pam replied, “I’ve infused ideas that I gleaned from people on and off, like new lab ideas.” I asked Courtney the question, “Are there changes you have made in your APES teaching?” She referred to a lab she heard about at the Reading and is using in her class. She said,

I had a problem with a lab that I was using for population growth and someone else was telling me that they do one with duck weed that is very effective and very economical and gives good results. So I’ve tried that one.

Redesigning labs. Three participants talked about changing the design and use of labs in their APES classes. John discussed the influence of the Reading on his lab design when he answered the question, “What factors influenced you on your journey to becoming an effective science teacher?” He stated, “The experimental design aspect, it was just a reinforcing type of thing at the Reading when lab questions came up.”

Participants also changed their perceptions regarding the purpose and importance of labs. Courtney referred to her changed view of the purpose of labs when she responded to the question, “What about any practices that have changed, does anything else come to mind?” She said,

I do labs differently. I now use the lab more as a learning tool in itself. This is a different approach, but I think that the students come more to their own conclusion. This is just something that has really worked for me that I did not use before.

In her answer to the same question, Denise replied, “I have students do things like setting up a lab experiment.”

Other Instructional Techniques

Fourteen of the 18 participants interviewed identified changes in their professional practice related to other instructional techniques. Specific areas mentioned by these 14 participants included problem solving/critical thinking (6), lecture (4), application (3),

calculations/conversions (3), current events journals (2), graphing (2), review techniques (2), and websites (1).

Though they did not provide specific explanations of how they changed these in instructional techniques, they clearly stated that changes had occurred. I asked John, “What are other factors that influenced you on your journey to becoming an effective science teacher? The Reading seems to be critical from what you’ve said thus far.” He talked about increased lab activities and new ways to do labs. He responded, “Students need more opportunities to solve problems.” I asked Allison, “What about the specific practices that you think have changed as a result of attending the APES Reading?” She explained the importance of teaching students to think more critically when she replied, “When I let them grade each other’s free response, I say you need to look for certain things before you start reading it. So they are getting better at thinking critically and also reading critically.”

Four participants spoke of lecturing less in their classrooms and doing more activities as a result of attending the Reading. I asked Allison, “Let’s look for a minute at how the Reading has influenced your teaching. Are there any changes that come to mind?” She responded,

I was a lot more rigid before I started coming and I lectured a lot. At the Reading I thought I’ve got to stop doing lecture and do a lot more group work, a lot more research, and a lot more labs and guide these students rather than lecture. Let them find it themselves. Let’s have some group discussions or a debate. I’ve gained a lot from that change.

I asked Carl, “What about how you covered the concepts? Has that changed?” He talked about lecturing less when he replied, “I do less lecturing than I did my first couple of years of teaching APES. I try to lecture one or two times a week max now. I do more labs and I utilize computers in the classroom more.”

Three of the 18 participants talked about increased application of environmental science concepts to the lives of their students. I asked Larry, “Has participation in the Reading influenced your teaching philosophy?” He stated,

I think that the Reading has helped me focus on being able to make my courses applicable to my students’ everyday lives. Because of hearing how other people teach and the activities they do, I can turn those around and mold them for the situation I’m in and for my students.

Three participants also spoke of increased use of calculations/conversions in their classrooms as a result of attending the Reading. I asked Jane, “Is there anything else in terms of practice change in your classroom?” She responded, “Since I don’t take anything for granted in terms of energy conversions and things like that, things they should have had the previous year, I do include more of them than I used to.” In response to the same question, Nancy replied, “I have encouraged more calculations, more math, and also more labs.”

Two interview participants talked about adding a new technique in their teaching. They now require students to keep a current events journal. I asked Larry, “Are there particular teaching practices that you’ve instituted or removed or things that you’ve done as a result of being here?” He stated.

One of the ideas that I learned here was a current events journal. I have my students every week through the course of the school year gather from either the newspaper or magazines or off an Internet website, an article about something happening in the environment dated that week. They write a 25-word summary and then develop a statement of personal relevance.

Two participants also talked about what they now require of students when graphing in their APES classes. I asked Pam, “Has participation in the Reading influenced assessment practices for you? Are there specific changes you have made?” She replied,

The kids called me the graphing Nazi when I was done this year because of what I learned in terms of graphing. I required more of them. It's helped them because I know more and it's helped them in other classes too.

Two interview participants discussed how they changed the way they review for tests as a result of attending the Reading. I asked Pam, "Has the Reading changed your view of important environmental science topics to cover?" She talked about a way she changed her review when she said,

I look at an idea and see how many attacks you can have to just one problem. That helped me tremendously in terms of my own approach to the subject and the way I finished subject matter when I reviewed the students.

One participant interviewed made reference to visiting a new website after going to the professional night activity at the Reading. As we were discussing professional night, I asked Carl, "Did those things that are of interest to you translate back to the classroom?" He responded, "A specialist from CDC came and that was really interesting. I've visited the CDC website fairly often since then and have included a new lesson in my teaching as a result of that."

Writing Skills

Ten of the 18 participants interviewed identified changes in their professional practice related to teaching writing skills to students. Though they did not identify specific teaching techniques they used, seven of the participants spoke of helping students become better writers, while three of the participants talked about focusing on writing in their classrooms.

Better writers. Bart talked about student writing when I asked the question, "Are there some specific changes in practice that you made as you attended the Reading?" He said, "By reading free-response questions, I've definitely learned how to teach kids to write. That is absolutely true." Four participants spoke specifically of helping students

become better writers. I asked Nancy, “What is it about the Reading that keeps you coming back?” She referred to helping students become better writers when she replied, “I’ve learned from the Reading how I can better coach students or prepare them in terms of what’s effective writing, how to not be long winded, but just be more precise and interconnect things.”

Martin also referred to student writing when he answered the question, “In what ways do you think the Reading has changed some of your thinking?” He responded,

I’m much more critical of student writing because when the kid said something you sort of assumed he’d know it, but he really probably didn’t. Being more critical makes them a better writer and it makes them think a little more. Coming here has made me a lot more critical of my students’ writing.

Two participants spoke of the importance of requiring students to explain terms more specifically when they write. Bob responded to the question, “Has participation in the APES Reading caused you to rethink your ideas about the important concepts you cover?” He referred to writing when he replied, “My list of buzz words that I’ll not accept is getting longer because they, you know, eco-babble. So I want to make sure they really know what terms mean.”

Focus on writing. I asked David, “What other assessments do you use?” He stated,

We do lab write-ups in different formats. I have them do consultant letters, traditional lab reports, land use plans as though they were an engineering firm, but I don’t do a big term paper in there. Sometimes they’ll do a one page summary sheet on endangered species or responses to issues, ethical issues regarding endangered species. I try to get them to write a lot.

Nancy spoke of her focus on writing when she answered the question, “Did the APES Reading influence your teaching?” She said, “It has influenced by teaching of writing in all my classes.” I asked Allison the question, “Do you think it is important for APES teachers to participate in the Reading?” She also spoke of writing when she

replied, “It opens up new techniques in teaching students how to write and stuff like that.”

Summary of Perceived Changes in Professional Practice

APES Reading teacher participants expressed a strong conviction that their professional practice changed as a result of attending the APES Reading. Fifty-one (96%) of the 53 veteran teacher participants surveyed and all 18 of the participants interviewed reported perceived changes in professional practice. Though comments were not always specific, it is apparent that participants perceive a significant change in their practice as a result of participation in the APES Reading. Of the 60 participants surveyed, 65% spoke of perceived changes in instructional techniques. An additional 51% reported perceived changes in assessment techniques, 22% reported perceived changes in lab techniques or lab use, and 8% reported perceived changes in their expectations or focus in the course.

All 18 interview participants mentioned perceived changes in instructional techniques. The largest category identified was labs, with 78% reporting perceived changes in lab use, types of labs, and lab design. This was followed by 67% reporting perceived changes in a variety of other instructional techniques focusing on topics such as problem-solving and critical thinking skills. Increased emphasis on teaching students writing skills was reported by 61% of the participants interviewed.

Perceived changes in assessment techniques were also a major area of focus identified by 89% of the APES Reading participants interviewed. The most common perceived changes in assessment focused on free response/essay use and rubric development and use. Eighty-nine percent of the participants interviewed also report perceived changes in the curriculum topics they covered.

Fourteen of the 18 participants interviewed identified a variety of changes related to other instructional techniques. Though they did not always specify the exact instructional techniques used, they did report a focus on areas such as problem solving and critical thinking skills, less lecture, more activities, and an increased focus on calculations and conversions. Ten of the 18 participants interviewed also identified instructional changes related to teaching writing skills and they provided examples of specific ways they help their students become better writers.

CHAPTER 7 DISCUSSION AND CONCLUSIONS

The purpose of this study was to determine the characteristics of APES teacher participants at the 2004 APES Reading, their perceptions of the professional benefits of the Reading, and perceived practice changes resulting from participation in the Reading. The research methods used were surveys and interviews. I felt surveys were the best method to obtain a picture of general teacher characteristics. The compilation of survey results did provide a picture of the general characteristics of this particular teacher group. Interviews were considered the best method to pursue additional information on teachers' views of professional benefits of the Reading and the resulting change in their teaching practices. During the interview process, interviewees elaborated on these areas and helped me obtain a more complete picture of their views of the Reading related to these two areas.

The first part of this chapter includes a discussion of study results regarding APES teacher characteristics, including a comparison of APES teachers with other teacher groups. The second part of this chapter focuses on criteria of effective professional development identified from previous research, and compares these criteria with Reading participants' perceptions regarding the APES Reading as a form of effective professional development. The third part provides recommendations for enhancing the professional development benefits of the APES Reading, while the fourth part identifies areas for future study.

APES Teacher Characteristics

This discussion of APES teacher characteristics focuses on participants' age, gender, education, teaching experience, and instructional techniques. These APES teacher characteristics are compared to characteristics of secondary teachers in general, science teachers, and/or AP teachers. In each of the areas listed, conclusions are also drawn about relationships between APES teacher characteristics and teacher effectiveness.

Age/Gender. Because there was no APES Reading participant under age 30 and the average age was 48, teachers attending the 2004 APES Reading were older than the general secondary teaching population where 16% are under age 30 and a total of 68% are under age 50 (Digest of Education Statistics, 2002). It is not possible to determine if this is a reflection of AP teachers being the older, more experienced teachers at their schools or simply an expression of who attended this particular Reading. It is also true that some of the teachers in this study moved into teaching later in life. However, several studies (Grissmer & Kirby, 1998; Stronge, 2002; Varella, 2000; Waxman & Walberg, 1991) indicate that increased teacher experience leads to increased teacher effectiveness. Because older teachers may have more teaching experience, this supports the hypothesis that AP teachers are more effective teachers than secondary teachers in general. School districts may determine that the experience level of their AP teachers is an important factor in the success of their AP students in passing the national AP exam.

The gender ratio of APES Reading teacher participants indicates that there is a higher percentage of male APES teachers (49%) than there is in the secondary teaching population in general where the percentages are 45% male and 55% female (Digest of Education Statistics, 2002). This may be a reflection of the gender ratio for science

teachers in general where the teaching population has a higher percentage of males.

Sadker and Sadker (1994) reported that 75% of high school science teachers are male.

The Third International Mathematics and Science Study (U. S. National Research Center, 2003), reported that 52% of eighth grade science students in the U.S. have male teachers.

No research was found regarding the influence of gender on teacher effectiveness.

Level of education. The percentage of APES Reading participants with master's degrees (68%), is higher than the percentage of master's degrees in the secondary teacher population in general (45%). In addition, five percent of the teachers in this study had Ph.D. degrees compared to only one percent of secondary teachers in general (Digest of Education Statistics, 2002). These results are not surprising because AP courses are the most demanding courses taught in high school and are comparable to college level courses. Colleges require a higher education level from their professors. It may also support data by Santoli (2002) that AP students feel they have the best teachers at their school since numerous studies (Fetler, 2001; Garmston, 1998; Harris, 1998; Okapala, Smith, Jones, & Ellis, 2000; Waxman & Walberg, 1991) support the notion that teacher effectiveness increases as a result of increased levels of education.

Advanced Placement Environmental Science has only been taught as a high school course since the 1997-98 school year. This may help explain the variety of subject areas in which APES participants hold degrees. No one at the high school where I taught held a degree in environmental science, so when the decision was made to offer the course, the administration chose me even though I had a degree in biology. Biology was the most common undergraduate degree of participants in this study (45%). This may be because there are more high school science teachers with degrees in biology than any other area;

it may indicate the more interdisciplinary thinking of biology teachers; or it may indicate the perception that environmental science is predominantly a biological science. It also reflects the finding of Stronge (2002) that 23% of teachers do not have degrees in the subject they are teaching and the finding of Klopfenstein (2003) that 24% of AP teachers do not have a degree in the subject they are teaching.

Teaching experience. APES teacher participants reported from 4 to 44 years of teaching experience with an average of 19 years of experience. The average number of years of experience for secondary teachers overall in 2001 was 14 (Digest of Education Statistics, 2002). APES teachers appear to have more teaching experience than secondary teachers in general. The effective teaching literature (Education Review Office, 1998; Fetler, 2001; Grissmer & Kirby, 1998; Rowan, Correnti, & Miller, 2002; Stronge, 2002; Varella, 2000) supports the conclusion that increased teaching experience leads to increased teacher effectiveness. This in turn supports the conclusion that APES teachers attending the 2004 Reading were more effective teachers than secondary teachers in general because they have more teaching experience than the secondary teaching populace.

Instructional techniques. The effective teaching literature (Brunkhorst, 1992; Cano, 2001; Doherty, Hilberg, Epaloose, & Tharp, 2002; Herr, 1992; Varella, 2000; Walls, Nardi, Minden, & Hoffman, 2002; Young & Shaw, 1999) supports the view that use of a wide variety of instructional techniques makes a teacher more effective. The APES teachers in this study reported using a wide variety of instructional techniques which supports the idea that APES teachers are effective.

Fifty-nine of the 60 study participants indicated they use lab activities as an instructional technique. No data was found in existing literature regarding the number of secondary teachers that use lab activities and inquiry-based teaching in their classroom instruction. However, the importance of activity-oriented, inquiry-based science instruction to effective teaching has been reported in several research studies (Bunkhorst, 1992; Mastropieri & Scruggs, 2001; Stronge, 2002; Wise, 1996). The use of lab activities by most of this study's participants would support the conclusion that APES teachers are effective teachers.

Though APES teachers reported using a variety of instructional techniques and lab activities, they also reported that their predominant instructional techniques are lecture and discussion (77%). These results are consistent with research results by the Third International Mathematics and Science Study (U. S. National Research Center, 2003) that reported most science classes focus on teacher-centered activities and results by Herr (1992) reporting that AP teachers spend the majority of their instructional time lecturing. The majority of instructional time being spent in lecture raises the question of how wide a variety of instructional techniques are actually practiced by APES teachers and how this influences their effectiveness as teachers.

Participants in this study also reported a high level of comfort with their science knowledge and pedagogical techniques (100%). These comfort levels are greater than those of secondary teachers in general who feel confident in their teaching (87%) and substantially higher than science teachers (27%) who feel confident in their teaching (U. S. National Research Center, 2003). This higher level of confidence is not surprising because APES teachers are older and more experienced than the general secondary

teaching population. This higher level of comfort may also be reflective of the greater number of graduate degrees held by these teachers, the large amount of non-degree related science and education coursework completed, and their participation in a wide variety of professional development activities.

The fact that APES 2004 Reading participants are older, more experienced, and more highly educated than teachers in the general secondary teaching population may help explain their use of a variety of instructional techniques and assessments, high levels of comfort with pedagogical practice and environmental science knowledge, and use of a wide variety of teaching resources. However, these same teacher characteristics could also explain the predominant use of more traditional instructional and assessment techniques. The focus on more teacher-directed, didactic instructional techniques could also reflect the vast amount of content covered in an AP course (Herr, 1992), a lack of available materials, or administration or parental expectations regarding how “college-level” science courses should be taught. In addition, because no labs are prescribed for APES, some participants may have determined that using labs on a regular basis is not a necessary part of the APES curriculum, a necessary component in student success on the APES exam, or both.

Conclusions. I found that APES Reading teacher participants exhibited many of the same characteristics of effective teachers that emerged in the literature review on effective teacher characteristics in general. In addition to effective teacher characteristics identified in the existing literature, APES teachers in this study also expressed a high degree of commitment to ongoing learning about content and pedagogy and student-centered learning.

Effective Professional Development

This study was conducted to explore the potential impact of the APES Reading as an effective professional development activity. This section presents criteria of effective professional development identified from a review of literature. Each of these criteria is compared to APES teachers' perceptions regarding effective professional development and the effectiveness of the APES Reading as a form of professional development.

The APES teacher participants' descriptions of effective professional development mirrored descriptions of effective professional development found in the review of literature. The findings of this study support the hypothesis that APES teacher participants understand and can identify components of professional development that are effective in increasing teacher effectiveness. The participants also indicated that their primary motivations for attending the Reading were related to its professional development aspects, not the honorarium provided. Their primary purpose in reading student essays was the rich source of knowledge gained, an opportunity to identify student misconceptions and then alter their instructional techniques accordingly, and the understanding they gained regarding assessment techniques.

The review of literature conducted for this study indicated the following criteria for effective professional development activities: active engagement by participants, collaboration through mentoring and teacher networks, field-based less traditional experiences, focus on increasing content knowledge and pedagogy, increased time spent on the professional development activity, and relevance of the professional development activity to classroom teaching. Specific findings of this study related to each of these aspects are discussed in the following sections.

Active engagement by participants. Several studies (Birman, Desimone, & Porter, 2000; Darling-Hammond & McLaughlin, 1995; Garet, 2001; Shepardson, Harbor, Cooper, & McDonald, 2002; Terrehoff, 2002) have reported the importance of professional development that actively engages participants. One interview participant in this study specifically mentioned active engagement in an activity as a criterion for effective professional development, while others spoke of the importance of their active participation in Reading activities.

The APES teachers in this study were actively engaged in the development and application of rubrics and were given opportunities for input in the overall design of the Reading. They were also actively engaged in interactions with other participants regarding content and instructional practices. Their Reading and scoring of essays was also a means of active participation. The Reading provided discretionary time for APES participants to engage in other activities, such as Professional Night, that provided professional development opportunities as teachers were exposed to new content knowledge. Participants commented on their active involvement in all of the activities and the benefit of these activities for them professionally and personally.

Collaboration through mentoring and teacher networks. Several studies report the effectiveness of collaboration in professional development (Birman, Desimone, & Porter, 2000; Davies, Brady, Rodger, & Wall, 1999; Denmark & Podsen, 2000; Morris, Chrispeels, & Burke, 2003; Pennell & Firestone, 1996; National Center for Education Statistics, 2001). The APES Readers in this study expressed the view that they were the only APES teachers at their schools and often the only AP teachers at their schools. The Reading participants were from different schools and regions of the country. This may be

the reason mentoring was not mentioned as a criterion for effective professional development by this study's APES teacher participants. They did report that the Reading performed a mentoring function during their interactions at the Reading as they bounced ideas off of each other and gained new insights and ideas. They also lamented the lack of APES mentors at their schools and expressed a desire to have mentors there.

Although the term networking was only mentioned by three of the teachers interviewed, interview and survey participants referred to the importance of the ideas they exchanged with teachers at the meeting, new people who were a source of information in areas where they felt weak, and correspondence with Professional Night speakers and other teachers after the Reading. They viewed the Reading as an opportunity to become connected with APES teachers all over the United States and thus provide a bank of teachers with which to network. The APES teacher participants also expressed the view that the Reading provided an opportunity for connections and exchanges that was not possible in other professional development activities they have attended.

Fifty-three of the 60 survey participants cited interactions with others as a motivation for attending the Reading. One-third of the survey participants reported interactions as their most important motivation and all of the interview participants referred to the importance of interactions with other teachers and the resources they gained from the Reading.

Field-based experiences. The APES Reading was not focused on participation in an environmental research project and the Reading did not permit immediate implementation of techniques in a school classroom. However, participants were given

opportunities to participate in environmental activities, exchange information about those activities, and discuss possible ways to implement various pedagogical techniques.

Focus on increasing teacher knowledge and pedagogy. Several studies (Garet, 2001; Guskey, 2003; Stronge, 2002) indicate the positive influence of effective professional development on teacher knowledge and pedagogy. Seven of the 18 APES Reading participants interviewed reported the importance of increased content knowledge and six of the 18 interviewees reported improvement in pedagogical techniques as a criterion for effective professional development. Survey comments and interview responses by APES teacher participants referred to their own increases in content knowledge and/or pedagogical techniques as a result of participation in the Reading. Through reading essays, developing rubrics, interactions with other APES teachers, interactions with college professors who teach environmental science, and attendance at Professional Night, APES participants were exposed to a plethora of new content knowledge and a variety of useful instructional techniques.

Increased time spent on the professional development activity. Several studies (Birman, Desimone, & Porter, 2000; National Center for Education Statistics, 2001) report that time spent in a professional development activity has a positive correlation with the effectiveness of that activity. Though interview participants in this study did not mention this factor as a criterion for effective professional development in their interviews, they did speak of the Reading as a concentrated time immersed in environmental science content and instructional aids. The interview participants and survey comments indicated that participants saw the APES Reading as an immersion experience from seven in the morning until ten or later at night. They reported that

because they were separated from teaching responsibilities and other commitments, they had the opportunity to spend significant time focused on environmental science topics and pedagogical techniques.

Relevance of the professional development activity to classroom teaching.

Several studies (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet, 2001; Lester, 2003; Stronge, 2002) reported that usefulness in the classroom is an important component of effective professional development. The importance of this criterion was also mentioned by half of this study's interview participants and appeared in numerous survey comments regarding perceived benefits of the Reading. The APES teachers in this study reported that they learned about many new ideas, lab activities, and instructional and assessment techniques that they could immediately implement in their APES teaching. Fifty-one of 53 survey participants and all 18 participants interviewed talked of changes in teaching practice they implemented in their classrooms as a result of participation in the Reading, indicating the usefulness of knowledge and techniques acquired at the Reading.

Overall conclusions about the effectiveness of the Reading as a form of effective professional development. Birman, Desimone, and Porter (2000), reported that less traditional methods of professional development are more effective because they spend more time, have a greater focus on content, and allow more active involvement by participants. They also reported that professional development is more effective when it includes teachers from the same subject area. If it is viewed as professional development, the APES Reading is non-traditional professional development. It includes teachers from the same subject area, spends concentrated time, focuses on content, and actively

involves participants. All of this supports the professional development effectiveness of the Reading.

Several studies (Birman, Desimone, & Porter, 2000; Desimone, Porter, & Garet, 2002; Darling-Hammond & McLaughlin, 1995; Shepardson, Harbor, Cooper, & McDonald, 2002) also support the importance of teacher engagement, observation, participation, and reflection in professional development. The APES Reading engages teachers as they provide input into rubric development and application and actively participate in reading and evaluating content knowledge. They are given time to reflect on their teaching and content knowledge, both alone and with other teachers.

The data from this study support the idea that the APES Reading is viewed by participants as a collaborative effort that allows time for reflection, relates to what they teach, allows them to actively engage in the process, and increases their content knowledge and pedagogical skills. The APES Reading participants saw these components as important to effective professional development and present in the current design of the Reading. There are certainly ways the APES Reading could be improved to increase its effectiveness as a professional development tool, but it is already considered by participants to be an effective development activity and is viewed by some participants as the best professional development activity they attend or have attended.

Recommendations for Enhancing the Professional Development Benefits of the APES Reading

The College Board conducts institutes and workshops on AP courses and recognizes their importance as professional development activities. The following statement is found on the College Board website regarding AP workshops and institutes. “A critical component involves addressing teachers’ particular needs in terms of course-

specific content and pedagogical knowledge” (AP Central, 2004). They also refer to building an “AP community.” Research indicates that increased content and pedagogical knowledge and networks are important components of effective professional development. These components are met in AP workshops and institutes.

Though the primary purpose of the APES Reading is grading of the essay portion of the national APES exam, the results of this study support the conclusion that the Reading is also effective in building teacher networks, increasing teachers’ content and pedagogical knowledge, and thus, functions as effective professional development. APES teacher participants expressed that their primary reason for attending the APES Reading was their interest in, and need for, further professional development. These teachers feel isolated from other APES teachers, feel a need to pursue interactions with other APES teachers, and expressed a need for knowledge and activities that directly translate into use in their classes.

In informal discussions during the Reading experience, participants commented they were glad I was pursuing this study because they felt the professional development aspect of the Reading was being missed in promotion of the Reading. They also felt the professional development aspect of the Reading is missed by administrators at their schools who do not understand the value of participation in the Reading to them as persons and as teachers.

How can the College Board take this existing program and expand its influence? Although the Readers were very positive in their responses about the organization of the Reading, several ideas emerged regarding increasing the Reading’s focus on professional development. The recommendations are:

- Reinstitute the lab/activity exchange
- Schedule veteran APES teacher participant presentations
- Schedule additional professional nights
- Utilize local college professors and community personnel
- Notify Readers of question assignments prior to attendance at the Reading
- Survey participants after the Reading regarding perceived professional development benefits.

Reinstitute the lab/activity exchange. The review of literature undertaken for this study found that usefulness to classroom teaching was an important component of professional development. APES teacher Readers who participated in the lab exchange in the past talked of its usefulness to them and participants who had heard of it also expressed their desire to participate. The lab exchange could be conducted as it was in the past where participants brought copies of their favorite labs to share with other participants. Another option would be to have a lab presentation night where participants volunteer to give a 2-5 minute presentation to introduce their lab, place copies of the lab out for participants to peruse, or obtain a brief description of labs and email addresses where the labs may be obtained. A few brief comments on potential problem spots would also be helpful. This same information could also be placed on a website. A ready source of good labs has the potential to increase lab use in this lab-based APES course and increase the quality of labs utilized.

Schedule teacher participant presentations. Increased content knowledge was also found to be an important component of effective professional development. Teachers in this study expressed their high regard for the varied abilities and areas of expertise of fellow Reading participants. Advanced Placement Environmental Science is a relatively

new course covering a broad range of topics in many science areas. The APES teachers are an experienced group of teachers from different regions of the country with different interests and subject area specializations.

The informal exchange of knowledge found to be important to teachers in this study could be expanded and become more effective if teachers had the opportunity to schedule time to present and share information related to their areas of expertise. This could consist of several presentations in one evening or a few different presentations during the course of the Reading. Veteran participants and important topics could be given first priority in scheduling. A published schedule of presenters and topics would enable participants to choose those areas of greatest interest or need to them personally and professionally.

Schedule additional Professional Night speakers. An increase in content knowledge regarding various environmental topics is an important aspect of professional development. Several teachers in this study expressed a desire for more Professional Night speakers. They also shared that increased knowledge obtained from and usefulness of Professional Night presentations in their classroom teaching. The College Board could schedule two or more professional night speakers instead of the one they currently schedule for each Reading. These speakers should not only be chosen because they are experts in their fields, but also chosen based on the importance of their particular area to the APES curriculum and the applicability of their topic to real-world classroom practice.

Schedule local professors and community personnel. Participants in this study also expressed a desire to see local professors and community personnel involved in presentations and field activities. They indicated the increase in content knowledge they

could receive from these local experts in environmental topics. They expressed that Professional Night speakers do not necessarily have to be flown in from other areas. The APES Reading always takes place on a college campus where there are experts in various environmental science topics. If the professors from the host school were given the opportunity, would they be willing to speak to APES teachers? This would not only increase content knowledge of participants, but also increase rapport building between professors and teachers which could have a positive impact on the Reading, the course, the students, the teachers, and the professors. University students in appropriate subject areas could also provide tours or talks regarding local environmental science topics.

All APES Reading sites also have access to local community personnel who could share their knowledge regarding local flora and fauna, give tours through local APES-related facilities, and discuss environmental issues. These interactions have the potential of increasing participant knowledge, building rapport with the community, and establishing networks of people that could be useful as future resources to APES teachers and their students.

Notify Readers of question assignments prior to attendance at the Reading.

Active engagement of participants and time spent in an activity were found to increase effectiveness of professional development activities. A few APES Readers stated a desire to know questions ahead of time so they could be better prepared to grade the question to which they are assigned. Currently, APES Readers do not know which of the four free-response questions they will be scoring until they arrive at the Reading. Notifying them in advance of the free-response question they will be scoring would enable them to better prepare for the question.

This prior notification would also effectively extend the time of the Reading as participants research their question in the days prior to the Reading and more actively engage them in the rubric development part of the Reading. Notifying them about questions prior to the Reading could give participants sufficient time to complete research in an area, especially if they are assigned to grade a question focusing on a topic they do not feel competent addressing. It would also enable Readers to consider options for a grading rubric. Both of these ideas have the potential to increase the level of material presented at the APES Reading, give a head start to rubric development, allow for more input from participants, and result in better prepared free-response scorers.

Survey Readers at the completion of the Reading. The Readers already view the APES Reading as a professional development activity, but survey comments and interview responses gave several responses for ways to improve the professional development aspect of the Reading. A survey at the end of the Reading would provide an opportunity for the Readers to share these ideas with the designers of the Reading.

The College Board could design a simple survey asking participants to: 1) provide suggestions on improving the APES Reading design, 2) identify most important aspects of the Reading to the participants and motivations for attending the Reading, 3) determine participant teacher characteristics, 4) evaluate the Professional Night speaker, 5) and suggest ways to enhance the professional development aspect of the Reading. They could also survey participants regarding problems they encountered related to the Reading, such as their school administrator's perceptions of the Reading's value and ways to help administrators see the value of the Reading to APES teachers. The College Board could also design a set of recommendations regarding this survey for administrators regarding

characteristics of teachers who benefit the most from participating in the Reading and why they benefit.

Proposed activity schedule for APES Reading participants. The following activities came from suggestions of Readers on how the APES Reading could be improved as a professional development activity. This schedule incorporates the ideas mentioned in the above suggestions. The proposed activities could occur in the morning prior to the Reading time or after the Reading ends each day. This scheduling option would enable Readers to focus on essay scoring during the Reading day and complete the essay scoring in the allotted time. An abbreviated schedule of activities, invitations and information on participation in the lab exchange and presentations, and free-response question assignments could be sent to the Readers prior to their arrival at the Reading. The schedule could also be enclosed in the booklet of information Readers receive when they check-in at the Reading site. Clarification should be made of the voluntary nature of participation in any or all of these supplemental activities.

- **Pre-Reading Social.** Readers arrive the afternoon and evening before Day 1 of the Reading. When they check-in they are reminded of the social for the evening. The social includes refreshments and an informal time of meeting and greeting held at the Commons.
- **Day 1: Lab Exchange on Biology topics relevant to the APES curriculum (7:30 p.m.-8:30 p.m.)** A schedule of labs available at the exchange could be published in the Gorilla Gazette (the daily announcement sheet given to Readers each morning). Participants who bring labs should have 40-50 copies of their lab available for Readers to pick-up. Readers are allowed to take a maximum of 10 labs at the exchange unless there are remaining copies of labs at the end of the time. If labs run out before all Readers have an opportunity to take one, Readers have the option to sign-up, pay \$1.00, and pick-up a copy at the next exchange. (A volunteer, or Table Leader, could take the list of desired labs to the closest copy center or give the money to ETS and use their copy facility.) As mentioned previously, they could also post the labs on a designated website.
- **Day 2: Early morning walk and evening veteran APES presentations on physical science topics relative to the APES curriculum**

- Early Morning walk (7:00 a.m.- 7:45 a.m.) hosted by a local university science student or university professor. This walk could provide information on local flora and fauna.
- Evening veteran APES presentations (7:00 p.m.-9:00 p.m.) scheduled every 15 minutes through the two hour period. The schedule of presenters and topics could be published in the morning Gorilla Gazette so Readers may choose topics they are interested in learning about.
- **Day 3: Professional Night presentation on a relevant APES topic (7:30 p.m.- 8:30 p.m.)** This talk could focus on a relevant environmental science topic to provide a real-world connection for the classroom. The speaker could also leave at least 5 minutes at the end for a question and answer period.
- **Day 4: Afternoon walk (or tour of APES related facility) and lab exchange on physical science topics relevant to the APES curriculum**
 - Afternoon walk (6:00 p.m.-6:45 p.m.) conducted by local community personnel, university student, or professor from host university.
 - Physical Science Topics Lab Exchange (8:00 p.m.-9:00 p.m.) announced and conducted in the same manner as Day 1 Biology Lab exchange.
- **Day 5: Veteran APES presentation on biological science topics relative to the APES curriculum (7:00 p.m.-9:00 p.m.)** announced and conducted in the same manner as Day 2 physical science presentations.
- **Day 6: Picnic and presentation by host university environmental science professor on relevant APES curriculum topic.**
 - The Picnic (5:30 p.m.-7:30 p.m.) could be a come and go affair by the lake or another outdoor area. This could provide a different setting for participant interaction and reflection. (Dinner in the cafeteria could be cancelled for the evening.)
 - Presentation by hosting university environmental science professor (8:00 p.m.-9:00 p.m.) regarding a relevant APES curriculum topic.
- **Day 7: End of the Reading party at the Commons (7:00 p.m.-9:00 p.m.)**. This culminating activity could include refreshments and engaging presentations by Readers related to each of the four free-response questions.
- **Available throughout the evening times:** sale of tickets for baseball games and access to campus bowling alley, pool, gym, and other facilities.

Recommendations for Future Study

Because of the exploratory nature of this study, it was stated in the introduction that it might produce more questions than answers. Though conclusions were drawn about the characteristics of the 2004 APES Reading teacher participants and their perceptions of effectiveness of the Reading as a professional development tool, several areas emerged during the course of this exploratory study that not only extend the current literature but

may provide the impetus for future studies. These areas include: gaps in the existing research literature, follow-up of Reading participants, and effectiveness of the Reading as professional development.

Gaps in the existing research literature. When conducting a review of research literature for this study, several gaps were identified. In some cases, no studies were found at all and in other areas, little or inconclusive research was found. Gap areas include: research on AP teacher characteristics, instructional methods used by AP teachers, research regarding instructional and assessment techniques used by secondary teachers in general, and the relationship between student achievement and effective teacher characteristics.

Specific questions deserving future research include: What are the characteristics of AP teachers and how do these characteristics compare with college professors in the same subject area? Is the focus on lecture helpful or detrimental to coverage of the AP curriculum? What are the assessment techniques used, resources used, personality characteristics, and levels of pedagogical expertise of secondary teachers in the U.S.? What teacher characteristics are most effective in influencing student achievement?

Follow-up of Reading participants. A second area to pursue in future research would be to follow-up on APES Reading teacher participants. This study focused on one Reading in one AP subject area. A longitudinal study of veteran AP Reading teacher participants, a study of different Reading years, or a study of different AP Readings might produce useful findings and lend support to the findings of this study.

Questions for potential investigation include the following: Are the findings from this APES Reading consistent with those from other APES Reading years in terms of

participant characteristics or participant perceptions regarding professional development and do the findings of this study apply to teachers attending other AP Readings? How effective is the Reading in changing the professional practice of participants and how many perceived changes in practice are instituted after returning home? Is the APES Reading an effective tool for improving student writing? How does participation in the Reading influence other courses participants teach?

Effectiveness of the Reading as professional development. A third area of future study could involve the effectiveness of the Reading as professional development. Further studies could be done to investigate other criteria of professional development in the APES Reading. Participants could be surveyed to determine what aspects of professional development are most important to the majority of Reading participants. Administrators and fellow teachers could also be surveyed to determine if they detect improvement in teaching or specific practice changes as a result of the participants' attendance at the Readings.

Potential questions in this area could include the following: Is the APES Reading an effective method of improving teacher effectiveness and education in the United States? Could the Reading be a model for other seminars or informal methods of professional development? What are the characteristics of teachers who perceive the Reading as effective professional development but do not make changes in their professional practice?

The major conclusions of this study are as follows.

- The APES teachers at the 2004 APES Reading are effective teachers.
- The APES teachers can identify the components of effective professional development.

- These teachers perceive those components of effective professional development do occur at the APES Reading.
- These teachers value the APES Reading as a professional development activity and report that their pedagogical practice has changed as a result of participation in the APES Reading.

The results of this study indicate that APES teacher Reading participants believe the APES Reading experience meets the criteria for effective professional development and also believe participation in the Reading experience has improved their effectiveness as teachers. As indicated repeatedly in the literature, increasing teacher effectiveness is viewed as one of the most significant ways to improve the quality of high school education in the United States. Given the documented role that professional development plays in the teacher improvement process, it is imperative that effective avenues of professional development be identified and utilized. Because the teachers participating in this study were highly educated, experienced, and committed to providing a first-rate education to their students, their views and perceptions deserve to be considered. Their recommendations and feedback can, and should, be used to modify the current structure of the APES Reading in order to further increase its effectiveness as a tool for professional development of teachers.

APPENDIX A
ADVANCED PLACEMENT ENVIRONMENTAL SCIENCE READING
PARTICIPANT QUESTIONNAIRE

Please answer each question as completely as possible and skip any question you are not comfortable answering. (All information is completely confidential.)

Name: _____

Part I: Motivations for Reading Attendance and Educational Philosophy/Practice

1. Below are some reasons teachers participate in the Readings. Do you share any of these motivations for participation? *(Check all that apply. Add additional motivations that apply to you. Provide comments if you so desire)*

_____ Administrative mandate
_____ Interest in environmental science
_____ Money
_____ Peer interaction opportunities (Type: _____)
_____ Other: _____
_____ Other: _____
_____ Other: _____

Comments: _____

2. Including the “Other” items you added above, rank the three motivations that are important to you and explain why. *(1 = Most important, 3 = Least important. Provide additional comments if you so desire)*

_____ Administrative mandate _____
_____ Interest in environmental science _____
_____ Money _____
_____ Peer interaction opportunities _____
_____ Other: _____
_____ Other: _____
_____ Other: _____

Comments: _____

3. Which of the following techniques do you regularly use in your AP Environmental Science (APES) instruction? (*Check all that apply. Add any others. Provide comments if you so desire.*)

<input type="checkbox"/> Computer Programs	<input type="checkbox"/> Field Trips/Outdoor Activities
<input type="checkbox"/> Cooperative Learning	<input type="checkbox"/> Lab Activities
<input type="checkbox"/> Drawing Activities	<input type="checkbox"/> Lecture
<input type="checkbox"/> Debates	<input type="checkbox"/> Role Play
<input type="checkbox"/> Demonstrations	<input type="checkbox"/> Videos
<input type="checkbox"/> Discussion	<input type="checkbox"/> Worksheets
Other: _____	
Other: _____	
Other: _____	
Comments: _____	

4. Including the “Other” items you added above, rank the techniques you checked to indicate how often you use them. (*1 = Most often. Provide additional comments if you so desire.*)

<input type="checkbox"/> Computer Programs	<input type="checkbox"/> Field Trips/Outdoor Activities
<input type="checkbox"/> Cooperative Learning	<input type="checkbox"/> Lab Activities
<input type="checkbox"/> Drawing Activities	<input type="checkbox"/> Lecture
<input type="checkbox"/> Debates	<input type="checkbox"/> Role Play
<input type="checkbox"/> Demonstrations	<input type="checkbox"/> Videos
<input type="checkbox"/> Discussion	<input type="checkbox"/> Worksheets
Other: _____	
Other: _____	
Other: _____	
Comments: _____	

5. Which of the following teaching resources do you regularly use in your APES course? (*Check all that apply. Add others. Provide comments if you so desire.*)

<input type="checkbox"/> AP Central	<input type="checkbox"/> Science-related newspaper,
<input type="checkbox"/> Internet Resources/Websites	<input type="checkbox"/> magazine articles
<input type="checkbox"/> Lab manuals	<input type="checkbox"/> Science reference books
<input type="checkbox"/> Other teachers	
Textbook (Provide the title and publisher if known.) _____	
Other: _____	
Other: _____	
Other: _____	
Comments: _____	

6. Including the “Other” items you added above, rank the three resources you use most often. (*1 = Most often, 3 = Least often. Provide additional comments if you so desire.*)

_____ AP Central	_____ Science-related newspaper, magazine articles
_____ Internet Resources/Websites	_____ Science reference books
_____ Lab Manuals	
_____ Other Teachers	
_____ Textbook	
_____ Other: _____	
_____ Other: _____	
_____ Other: _____	
Comments: _____	

7. Which of the following assessment techniques do you regularly use in your APES course? (*Check all that apply. Add any others. Provide comments if you so desire.*)

_____ Essay Tests	_____ Research Papers
_____ Homework Assignments	_____ Short Answer/Fill in the Blank Tests
_____ Individual or Group Projects	_____ Student Portfolios
_____ Lab Reports	_____ True-False Tests
_____ Multiple Choice Tests	
_____ Open Note Tests	
_____ Other: _____	
_____ Other: _____	
Comments: _____	

8. Including the “Other” items added above, rank the assessment techniques you checked to indicate how often you use them. (*1 = Most often. Provide additional comments if you so desire.*)

_____ Essay Tests	_____ Research Papers
_____ Homework Assignments	_____ Short Answer/Fill in the Blank Tests
_____ Individual or Group Projects	_____ Student Portfolios
_____ Lab Reports	_____ True-False Tests
_____ Multiple Choice Tests	
_____ Open Note Tests	
_____ Other: _____	
_____ Other: _____	
Comments: _____	

15. Of the aspects you listed above, which ones do you find most professionally rewarding and why?

16. Has participation in APES Reading changed your professional practice? (*Please check*) Yes ___ No ___

17. If you answered yes to item 16, please explain how your practice has changed. If you answered no to item 16, please explain why not.

Are you willing to participate in a 45-minute confidential interview during one evening this week? (*Please check*) Yes ___ No ___

Part III: Demographic Information/Employment History

18. Sex (*Please check*): Male ___ Female ___

19. Age (*in years*): _____

20. College Degrees (*Most recent to oldest*)

Major	Degree (<i>e.g. B.S., M.S., Ph. D., etc.</i>)	Institution	Year

21. K-12 Education Employment History. (*Please list your 3 most recent positions in K-12 education. Most recent to oldest*)

Job Title (<i>teacher, science supervisor, etc.</i>)	State/ Country	If Teaching, Subjects Taught	Years of Employment (<i>e.g. 2000-2003</i>)

22. Science-related Employment History. *(Please list your three most recent science-related positions outside K-12 education. For example, College/University science teaching or other science-related employment. Most recent to oldest.)*

Job Title	State/Country	Years of Employment (e.g. 1985-1990)

23. Advanced Course Teaching Experience other than AP Environmental Science
(Most recent to oldest)

Course Name	Number of Years Taught	Level (AP, IB, Honors)

24. Participation in Other Advanced Placement Readings

Subject Area	Check if You Participated	Years Participated (e.g. 1980-1985)
AP Biology		
AP Chemistry		
AP Physics		
Other (<i>name</i>)		

25. Number of years teaching at your current school: _____
26. Total number of years of K-12 teaching experience: _____
27. Number of sections of APES taught this past school year: _____

Part IV: Professional Development Experiences

28. Have you completed college/university coursework that is not part of a degree program? *(Please check.)* Yes ____ No ____
29. If you answered Yes to item 28, please list the total number of courses completed:
Science Content Coursework _____ Education Coursework _____

30. Professional Service:

Activity	Years Service Provided (<i>e.g.</i> 1990-1999)	Total Number of Years
Mentor Teacher		
Intern/Student Teacher Supervisor		
Other (<i>name</i>)		
Other (<i>name</i>)		
Other (<i>name</i>)		

31. Type of Formal and Informal Professional Development Participation

Type	Name of Conference or Type of Activity	Check if Presented	Check if Attended	Years Participated (<i>e.g.</i> 1999)
State Education Conference				
Inservice Workshop (1 day or less)				
National/International Education Conference				
Summer Institute or other Multi-day Enrichment Program				
Other				
Other				

32. Professional Science or Educational Magazines/Journals Received

Name of Magazine/Journal	Total Number of Years Received

33. Professional Organizations

Organization	Please Check if Ever a Member	Current Member (Y/N)	Total Years of Membership	Officer/Other Leadership Role (Please describe)
NSTA				
NABT				
AAPT				
NAAEE				
State/Regional Science Education Organization				
State/Regional Environmental Education Organization				
Other (name)				
Other (name)				

34. Awards/Recognitions (Please check if you have received any of the following and list the year received.)

Award	Check if Received	Years Received
School Teacher of the Year		
County/District Teacher of the Year		
State Level Award		
National Level Award		
National Board Certification		
Other (name)		
Other (name)		

Additional comments you would like to add. (Use the back page if you would like more space.)

APPENDIX B
ADVANCED PLACEMENT ENVIRONMENTAL SCIENCE PARTICIPANT
INTERVIEW QUESTIONS

About Your Teaching

1. What is your definition of effective science teaching? What practices would you expect to see in an effective science teacher's classroom?
2. At this point in your career, how close are you to this vision of an effective science teacher?
3. What factors/experiences have helped you in reaching this vision of an effective science teacher?
4. What factors/experiences have hindered you in reaching this vision of an effective science teacher?
5. Are there changes you'd like to make in your APES teaching? If so, what are they? Why?
6. What types of assessments do you use to evaluate student learning in APES? Why these?

About the APES Reading

7. What is it about the APES Reading that keeps you coming back?
8. Is it important for APES teachers to participate in the Reading? Why or why not?
9. What's the best thing about the APES Reading? Why?
10. What's the worst thing about the APES Reading? Why?
11. If you were organizing the APES Reading, how would you set them up? Why?
12. What do you consider to be important criteria of effective professional development?

13. Do you think APES Reading meets any of the criteria you identified in number 12? If so, which ones? How?
14. Are there adjustments that could be made to improve the impact of the APES Reading as a professional development experience? If so, what?
15. How could the APES Reading be made more beneficial to the readers?

Impact of the APES Reading On Your Teaching

14. Has participation in the Reading influenced your teaching philosophy? In what way(s)?
15. Are there specific changes you have made in your teaching as a result of participation in the APES Reading? If so, what is an example of that change?
16. Has participation in the APES Reading caused you to rethink your ideas about important environmental science concepts that students should learn? Tell me about this.
17. Has your participation in APES Reading influenced your assessment practices? If so, in what ways? If not, why not?

APPENDIX C
2004 APES READING SCHEDULE

Daily Reading Schedule

8:00 a.m.-4:45 p.m. Daniel Hall

Dining and Break Schedule

- 6:30 a.m.-8:00 a.m. Breakfast : Schilletter Dining Hall
- 10:00 a.m.-10:15 a.m. Break
- 12:15 a.m.-1:15 p.m. Lunch: Schilletter Dining Hall
- 3:00 p.m.-3:15 p.m. Break
- 5:00 p.m.-7:00 p.m. Dinner: Schilletter Dining Hall

Special Events Schedule

- Monday May 31
 - 8:00 a. m. Pre-Reading Leader Meetings: Daniel Hall
- Tuesday, June 1
 - 8:00 a.m. Pre-Reading Leader Meetings: Daniel Hall
 - 6:00 p.m. Table Leader Dinners: Calhoun Corners Restaurant
- Wednesday, June 2
 - 8:00 a.m. Pre-Reading leader Meetings: Daniel Hall
- Thursday, June 3
 - 8:00 a.m. APES Orientation: Daniel Hall Auditorium
- Friday, June 4
 - 6:30 p.m.. College Board Regional Receptions: Brackett Hall
 - 7:30 p.m. AP Open Forum: Brackett Hall Auditorium

- 9:15 p.m. Movie: McKissick Theater
- Saturday, June 5
 - 7:30 p.m. Environmental Science Professional Night
 - 9:00 p.m. Movie: McKissick Theater
- Sunday, June 6
 - 6:00 p.m.. Bowling: On Campus
 - 9:00 p.m. Movie: McKissick Theater
- Monday, June 7
 - 5:30 p.m. Tangier Mall Outlets
 - 5:30 p.m.. Base ball Game: Ticket purchase Daniel Room 218
- Wednesday, June 9
 - Final Day of Reading
 - 5:00 p.m. APES Debriefing Session: Brackett Hall
 - 7:00 p.m. Closing Day Parties

APPENDIX D
DESCRIPTION OF INTERVIEW PARTICIPANTS

Table D.1: Description of Interview Participants

Participant Name (synonym to protect anonymity)	Years of Teaching Experience (K-12)	Highest Degree: Level and Subject Area	Years of Participation in Previous APES Readings	Number of Sections of APES Taught in 2004	Region of Country
Allison	17	Bachelor's in Microbiology	3	4	Southeast
Anita	18	Master's in Science Education	1	1	Southeast
Bart	8	Master's in Environmental Science	3	2	Southwest
Bob	20	Master's in Biology	6	2	Northeast
Carl	18	Master's in Geology	3	2	Southwest
Courtney	20	Bachelor's in Biology	5	1	South
David	11	Master's in Biology	4	1	Northeast
Denise	28	Bachelor's in Biology and Chemistry	5	1	South
Jane	27	Master's in Environmental Science	5	2	Northeast
John	17	Bachelor's in Biology Education	6	6	West
Kathy	35	Master's in Environmental Science	6	0 (2 last year)	Northeast
Larry	24	Master's in Science Education	5	2	Northeast
Marlene	11	Ph. D. in Genetics	6	2	Southeast

Table D.1. Continued

Participant Name (synonym to protect anonymity)	Years of Teaching Experience (K-12)	Highest Degree: Level and Subject Area	Years of Participation in Previous APES Readings	Number of Sections of APES Taught in 2004	Region of Country
Martin	38	Master's in Chemistry and Physics Education	5	1	Northeast
Nancy	21	Master's in Education	2	2	Southwest
Pam	33	Bachelor's in Geography	1	1	Northeast
Sue	19	Bachelor's in Biology	1	5	South
Tom	18	Master's in Integrated Science	4	2	Southwest

APPENDIX E
COVER LETTER

June, 2004

Dear APES Participant:

My name is Freda Crawford. I taught high school science for over 20 years and have been involved in the APES readings for the past six years, as both a reader and a table leader. My personal experiences as a reading participant have made me curious about the possible impacts of the reading experience on teachers.

In 2001 I began work on a Ph. D. in science education at the University of Florida and decided to conduct my dissertation research on the potential of the APES readings as a professional development activity for teachers. I am excited that The College Board and the Educational Testing Service have given me permission to conduct this research. My study focuses on the following factors:

- General characteristics of teachers who attend APES readings (including variables such as education background, experience, teaching history, educational philosophy, and classroom practices).
- Aspects of the APES readings teacher participants view as most professionally beneficial.
- Teacher reports of how their professional practice has changed as a result of participation in the APES readings.

Because this is an exploratory study, I think the best way to collect data is to administer a brief questionnaire to all teacher participants and then conduct follow-up interviews with a sample of volunteers. I would appreciate it so much if you would:

- Sign one copy of the University of Florida informed consent form and leave it attached to the packet. You may take the other copy for your records.
- Complete the questionnaire. It may appear lengthy but it is formatted to make it easy to complete.
- If you are a returning reader, please consider volunteering to be interviewed. You may keep the attached copy of the interview focus questions to peruse ahead of time.
- Return your completed questionnaire and signed informed consent form at your earliest convenience to your question leader or put it in the box provided outside of Daniel 218.

All of your responses will remain completely confidential. I only need your names on the questionnaire in order to correlate it with the interview responses. Names will also provide proof that the questionnaires were completed by this year's participants.

I hope to have my data analyzed and written up by November of this year. If you are interested in receiving a copy of the research results or have any questions, you may reach me at fredagary@msn.com or call me at 352-332-0076. This week you may reach me on my cell phone (352-219-8243) or at the Hampton Inn (864-653-7744). Thank you so much for your willingness to participate in this research. I am very appreciative.

Sincerely,

Freda Crawford

REFERENCES

- AP Central. (2004) About the exam. Retrieved October 17, 2004, from the College Board Web site: <http://www.apcentral.collegeboard.com/teachers>.
- Bain, S. K., Bourgeois, S. J., & Pappas, D. N. (2003). Linking theoretical models to actual practices: A survey of teachers in gifted education. *Roepers Review*, 25(4), 166-172.
- Birman, B. F., Desimone, L. M., & Porter, A. C. (2000). Designing professional development that works. *Educational Leadership*, 57(8), 28-33.
- Blackwell, P. J. (2004). Putting the system together: Lessons learned by the Eisenhower initial teacher development programs. *Action in Teacher Education*, 25(4), 38-47.
- Boyle, R. R., (2003). Scholarly retreat. *Journal of Staff Development*, 24(3), 42-44.
- Brunkhorst, B. J. (1992). A study of student outcomes and teacher characteristics in exemplary middle and junior high science programs. *Journal of Research in Science Teaching*, 29(6), 571-583.
- Cano, J. (2001). What is known about effective teaching. *The Agricultural Education Magazine*, 74(3), 6-7.
- Cardellichio, T. L. (1997). The lab school: A vehicle for curriculum change and professional development. *Phi Delta Kappan*, 78(4), 785-788.
- College Board. (2001). *Advanced placement program*. (Available from College Board, 45 Columbus Avenue, New York, NY 10023)
- Crotty, M. (1998). *The foundations of social research*. London: Sage.
- Darling-Hammond, L. (1996). The quiet revolution: Rethinking teacher development. *Educational Leadership*, 53, 4-10.
- Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 76(4), 597-604.
- Davies, M. A., Brady, M., Rodger, E. & Wall R. T. (1999). Mentors and school-based partnership: Ingredients for professional growth. *Action in Teacher Education*, 21(1), 85-96.
- Deily, J. P. (2002). Teaching quality viewed as crucial. *Education Week*, 21(42), 5.

- Denmark, V. M., & Podsen, I. J. (2000). The mettle of a mentor. *Journal of Staff Development, 21*(4), 18-22.
- Desimone, L. M., Porter, A. C., Garet, M. S., Yoon, K. S., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Education Evaluation & Policy Analysis, 24*(2), 81-112.
- Dexter, L. A. (1970). *Elite and specialized interviewing*. Evanston, IL: Northwestern University Press.
- Digest of Education Statistics. (2002). Retrieved October 7, 2004, from the National Center for Education Statistics Web site: <http://www.nces.ed.gov/programs/digest>.
- Doherty, R. W., Hilberg, R. S., Epaloose, G., & Tharp, R. G. (2002). Standards performance continuum: Development and validation of a measure of effective pedagogy. *The Journal of Educational Research, 96*(2), 78-89.
- Education Review Office. (1998). The capable teacher. Retrieved October 9, 2004, from the Education Review Office Web site: <http://www.er.govt.nz/Publications>.
- Fetler, M. (2001). Student mathematics achievement test score, dropout rates, and teacher characteristics. *Teacher Education Quarterly, 28*(1), 151-168.
- Firestone, W. A. (1987). Meaning in method: The rhetoric of quantitative and qualitative research. *Educational Researcher, 16*(7), 16-21.
- Fisher, D. L., & Kent, H. B. (1998). Associations between teacher personality and classroom environment. *Journal of Classroom Interaction, 33*(1), 5-13.
- Foot, C., Vermette, P., Wisniewski, S., Agnello A., & Pagano, C. (2000). The characteristics of bad high school teachers reveal avoidable behaviors for new teachers. *Education, 121*(1), 128-134.
- Garet, M. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.
- Garmston, R. J. (1998). Becoming expert teachers. *Journal of Staff Development, 4*(4), 60-63.
- Glesne, C. (1999). *Becoming qualitative researchers: An introduction*. New York: Longman.
- Goetz, J. P., & LeCompte, M. D. (1984). *Ethnography and qualitative design in educational research*. Orlando: Academic.
- Grier, T. B. (2002). Advanced placement: Access to excellence. *Principal Leadership, 2*(8), 16-19.

- Grissmer, D., & Kirby, S. N. (1998). Teacher turnover and teacher quality. *Teachers College Record*, 99(1), 57-61.
- Guskey, T. R. (2003). Analyzing lists of the characteristics of effective professional development to promote visionary leadership. *NASSP Bulletin*, 87, 4-20.
- Hatch, J. A. (2002). *Doing qualitative research in education settings*. Albany, NY: State University of New York Press.
- Harris, A. (1998). Effective teaching: A review of the literature. *School Leadership & Management*, 19(2), 169-184.
- Henderson, J., Winitzky, N., & Kauchak, D. P. (1996). Effective teaching in advanced placement classrooms. *Journal of Classroom Interaction*, 31(4), 29-35.
- Herr, N. E., (1992). A comparative analysis of perceived influence of advanced placement and honors programs upon science instruction. *Journal of Research in Science Teaching*, 29(5), 521-532.
- Hinton, S., & Stockburger, M. (1991). Personality trait and professional choice among pre-service teachers in Eastern Kentucky. In D. Kiersey & M. Bates , Please understand me: Character and temperament types. Del Mar, CA. Prometheus Nemesis.
- Hovsepian, K. (1996). The teacher growth and development model. *American Secondary Education*, 24(3), 5-10.
- Huffman, D., Thomas, K., & Lawrenz, F. (2003). Relationship between professional development, teachers' instructional practices, and the achievement of students in science and mathematics. *School Science and Mathematics*, 103(8), 378-387.
- Kauchak, D. P., & Eggen, P. D. (1998). *Learning and teaching: Research-based methods*. Boston: Allyn and Bacon.
- Kellaher, A., & Maher, J. (2003). My mentor, myself. *National Staff Development Council*, 24(4), 31-35.
- Kimmel, H. Deek, F. P., & Farrell, M. L. (1999). Meeting the needs of diverse student populations: Comprehensive professional development in science, math, and technology for teachers of students with disabilities. *School Science and Mathematics*, 99(5), 241-249.
- Kindsvatter, R., Willen, W., & Ishler, M. (1996). *Dynamics of effective teaching*. White Plains, NY: Longman.
- Kitano, M. K., & Pedersen, K. S. (2002). Action research and practical inquiry teaching gifted English learners. *Journal for the Education of the Gifted*, 26(2), 132-147.

- Klopfenstein, K. (2003). Recommendations for maintaining the quality of advanced placement programs. *American Secondary Education*, 32(1), 39-48.
- Kotrlik, J. W., Harrison, B. C., & Redmann, D. H. (2000). A comparison of information technology training sources, value, knowledge, and skills for Louisiana's secondary vocational teachers. *Journal of Vocational Education Research*, 25(4), 396-444.
- Lawrence, G. (1979). *People types and tiger stripes* (2nd ed.). Gainesville, FL: Center for Applications of Psychological Types.
- Lester, J. H. (2003). Planning effective secondary professional development programs. *American Secondary Education*, 32(1), 49-61.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.
- Long, M. (1996). Systemic reform: A new mantra for professional development. *Mathematics Teacher*, 89, 584-587.
- Ma, Y., & Runyon, L. R. (2004). Academic synergy in the age of technology: A new instructional paradigm. *Journal of Education for Business*, 79(6), 367-371.
- Marshall, J. (1981). Making sense as a personal process. In P. Reason & J. Rowan (Eds.), *Human inquiry: A sourcebook of new paradigm research* (pp. 395-399). New York: John Wiley.
- Marso, R. N., & Pigge, F. L. (1990, October). Relationships between prospective teachers/personality attributes and changes in concerns about teaching during training. Paper presented at the annual meeting of Midwestern Educational Research Association, Chicago, IL.
- Mastropieri, M. A., & Scruggs, T. E. (2001). Promoting inclusion in secondary classrooms. *Learning Disability Quarterly*, 38(4), 265-274.
- McCutcheon, J. W., Schmidt, C. P., & Bolden, S. H. (1991). Relationship among selected personality variables, academic achievement, and student teaching behavior. *Journal of Research and Development in Education*, 24, 38-44.
- Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Josey-Bass.
- Moir, E., & Bloom, G. (2003). Fostering leadership through mentoring. *Educational Leadership*, 60(8), 58-60.
- Morris, M., Chrispeels, J., & Burke, P. (2003). The power of two: Linking external with internal teachers' professional development. *Phi Delta Kappan*, 84(10), 764-768.
- Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage.

- National Center for Education Statistics. (2001). *Teacher preparation and professional development: 2000*. Washington, DC: U.S. Department of Education.
- National Commission on Teaching and America's Future. (2003). *No dream denied: A pledge to America's children*. Retrieved September 22, 2004 from the National Commission on Teaching and America's Future Web site: <http://www.nctaf.org/home>.
- Okapala, C. O., Smith, F., Jones, E., & Ellis, R. (2000). A clear link between school and teacher characteristics, student demographics, and student achievement. *Education, 120*(3), 487-494.
- Ornstein, A. C., & Hunkins, F. P. (2004). *Curriculum: Foundations, principles, and issues*. New York: Pearson Education.
- Patton, M. Q. (1985, April). Quality in qualitative research: Methodological principles and recent developments. Invited address to Division J of the American Educational Research Association, Chicago.
- Pedretti, E., Mayer-Smith, J., & Woodrow, J. E. J. (1999). Teaming technology enhanced instruction in the science classroom and teacher professional development. *Journal of Technology and Teacher Education, 7*(2), 131-143.
- Pennell, J. R., & Firestone, W. A. (1996). Changing classroom practices through teacher networks: Matching program features with teacher characteristics and circumstances. *Teachers College Record, 98*, 46-76.
- Rean, A. A., & Baranov, A. A. (1998). Factors in teachers' tolerance of stress. *Russian Education and Society, 40*(5), 52-68.
- Reid, A. O., (1992). Computer management strategies for text data. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (Vol. 3, pp. 125-129). London: Sage.
- Rowan, B., Correnti, R., & Miller R. J. (2002). What large-scale, survey research tells us about teacher effects on student achievement: Insights from the prospects study of elementary schools. *Teachers College Record, 104*(8), 1525-1567.
- Rubin, H. J., & Rubin I. S. (2005). *Qualitative interviewing: The art of hearing data*. Thousand Oaks, CA: Sage.
- Sadker, M., & Sadker, D. (1994). *Failing at fairness: How our schools cheat girls*. New York: Simon & Schuster.
- Santoli, S. P. (2002). Is there an advanced placement advantage? *American Secondary Education, 30*(3), 23-35.

- Schwandt, T. A. (1997). *Qualitative inquiry: A dictionary of terms*. Thousand Oaks, CA: Sage
- Sears, S. J., Kennedy J. J., & Kaye, G. L. (1997). Myers-Briggs personality profiles of prospective educators. *The Journal of Educational Research*, 90(2), 195-202.
- Shaw, K. E. (1978). Understanding the curriculum: The approach through case studies. *Journal of Curriculum Studies*, 10(1), 1-17.
- Shelton, C. M. (2003). Emotional awareness: Fundamental to effective teaching. *Independent School*, 62(3), 62-64.
- Shepardson, D. P., Harbor, J., Cooper, B., & McDonald, J. (2002). The impact of a professional development program on teachers' understandings about watersheds, water quality, and stream monitoring. *The Journal of Environmental Education*, 33(3), 34-40.
- Smerdon, B. A., Burkam, D. T., & Lee, V. E. (1999). Access to constructivist and didactic teaching: Who gets it? Where is it practiced? *Teachers College Record*, 101(1), 5-34.
- Smith, L. M. (1978). An evolving logic of participant observation, educational ethnography and other case studies. In L. Shulman (Ed.), *Review of Research in Education*. Itasca, IL: Peacock.
- Sparks, D. (1997). A new vision for staff development. *Principal*, 77(9), 20-22.
- Spradley, J. P. (1980). *Participant observation*. New York: Holt, Rinehart, and Winston.
- Stronge, J. H. (2002). *Qualities of effective teachers*. Alexandria: Association for Supervision and Curriculum Development.
- Terehoff, I. I. (2002). Elements of adult learning in teacher professional development. *NASSP Bulletin*, 86, 65-77.
- Thomas, J. (1991). The numbers game: History in the schools. *Humanities*, 12(4), 20-21.
- U. S. National Research Center. (2003). Third International Mathematics and Science Study. Retrieved January 3, 2003, from the U.S. National Research Center Web site: <http://ustimss.msu.edu/info.html>
- Varrella, G. F. (2000). Science teachers at the top of their game: What is teacher expertise? *The Clearing House*, 74(1), 43-45.
- Wade, K. S. (1999). EE teacher inservice education: the need for new perspective. *The Journal of Environmental Education*, 27, 11-17.

- Walls, R. T., Nardi, A. H., Minden, A. M., & Hoffman, N. (2002). The characteristics of effective and ineffective teachers. *Teacher Education Quarterly*, 29(1), 39-48.
- Waxman, H. C., & Walberg, H. J. (1991). *Effective teaching: Current research*. Berkeley: McCutchan.
- Wise, K. C. (1996). Strategies for teaching science: What works? *The Clearing House*, 69(3), 337-338.
- Wolcott, H. F. (1994). *Transforming qualitative data: Description, analysis, and interpretation*. Thousand Oaks, CA: Sage.
- Yin, T. K. (2003). *Case study research: Design and methods*. Thousand Oaks: Sage.
- Young, S., & Shaw, D. G. (1999). Profiles of effective college and university teachers. *The Journal of Higher Education*, 70(6), 670-686.
- Zimmerman, J. A., & May, J. J. (2003). Providing effective professional development: What's holding us back. *American Secondary Education*, 31(2), 37-48.

BIOGRAPHICAL SKETCH

Freda Mangle Crawford was born on October 12, 1949, in Lake City, Florida. She graduated from Columbia High School in Lake City, Florida, in 1967. She then attended Lake City Community College on an academic scholarship, was president of the student body her sophomore year, and graduated with an Associate of Arts degree in 1969. In 1970, she began a degree in biology education at Florida State University. After marriage to Gary Crawford, she transferred to the University of West Florida, where she was awarded a bachelor's degree in biology education in 1970.

Freda taught middle school in Milton, Florida, for 3 years and then high school algebra for one year. After moving to Texas in 1976, she taught Biology for 1 year at Crowley High School in Crowley, Texas. Upon returning to Florida in 1981, she began substitute teaching in elementary through high school. In 1983, she began teaching in the science department at Buchholz High School and continued teaching there until she took medical leave on January 18, 2000.

Freda received a Master's Degree in Science Education from the University of Florida in August, 1990. She began her Doctor of Philosophy degree in the School of Teaching and Learning in January 2001. While working on her doctorate, she taught science practicum students and supervised science interns. She plans to continue teaching at the postsecondary level after receiving her Doctor of Philosophy degree in May 2005.