EVALUATING THE IMPACT OF A BIOLOGY I PROFESSIONAL DEVELOPMENT SERIES

By

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Effective professional development offers opportunities for teachers to reflect on their practices, modify and implement changes in the classroom, and eventually impact students’ learning. However, professional development must be evaluated to determine whether the desired results are actually occurring in the classroom. The Program for Research and Evaluation for Public Schools, Inc. (PREPS) created a Biology I Workshop series to assist school districts in Mississippi in aligning curriculum, instruction, and assessment that will ultimately improve student achievement in the classroom and performance on the current high-stakes test. This study evaluated the PREPS Biology I Subject Area workshops by using Thomas Guskey’s evaluation model as a guide for the process.

This study used a mixed-method design and collected data from three primary sources: the PREPS Final Evaluation Form completed at the conclusion of workshops, a questionnaire created by the researcher, and interviews with six-case study teacher
participants selected from the results of the questionnaire. According to the ratings and comments written on the two instruments and supporting evidence from the case-study teachers, the participants of the Biology I workshop found the workshops to be effective for all five levels of Guskey’s evaluation model. The content was rated effective because the workshop materials were aligned to the curriculum frameworks and were focused on using student learning to improve student achievement. Working through the activities rather than simply being told about them and having a successful classroom biology teacher as a presenter were the factors that contributed to the increase in the participants’ knowledge and skills. Organizational results indicate that the workshop was effective in that the goals of the workshop series aligned with the schools’ mission and goals for student learning. Several issues, such as financial support, time for collaboration with peers, and reward opportunity for successful teachers, were rated low in school organizational structures. The results also indicate that the PREPS Biology I workshops had a positive impact on student achievement both in the classroom and on the Mississippi Biology I Subject Area Test for the schools that implemented the teaching units and strategies.
DEDICATION

This dissertation is dedicated to several people who have had a major impact on my life. First, I dedicate this work to my son, Brett, who has overcome so much in his life. When you were four, doctors told me that you would never be in a regular classroom, yet you have graduated from high school with honors and are attending a community college on a full band scholarship. You are truly an inspiration to me and I am so proud of your academic and musical accomplishments. I guess the word “can’t” has never been in our vocabulary.

Second, I dedicate this research to my family who never let me forget about my degree. My husband, Chuck, continues to support me through my demanding job and my long hours of work. Thanks for your patience, love, and for always being my best friend. I also dedicate this to my sister, Emily, whose relentless encouragement keeps me focused on what is really important in life. I would also like to dedicate this posthumously to my parents, Lois and Andrew Scipper, for instilling in me the importance of an education. You taught me through words and example that hard work never hurt anyone.

Lastly, I dedicate this to two people who had a profound impact on my teaching career, Dr. Rosalina Hairston and Virginia Malone. Rosalina, you challenged me when I needed it and made me realize so much about my own potential as a teacher. Virginia,
your knowledge of scientific inquiry and assessment is profound. Thank you for the realization that it is not the facts we convey, but the questions we ask that make us true educators.
ACKNOWLEDGEMENTS

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To the PREPS organization, Dr. Dilworth, Cindy, and Sarah, thanks for your support and encouragement in conducting this study. I am proud of the work you have accomplished and the services you provide our school districts for school improvement.

I would like to express my gratitude to all the teachers who participated in this study and especially those teachers who welcomed me into their classroom. Thank you for your honesty, generosity, and your commitment to education. I applaud your dedication to the teaching profession and your positive influence on our students.
To my Harcourt family, Earl, Marion, Benecia, Virginia, Marilyn, Trudy, Loraine, Esther, Nicole, Michele, and Pedro, I thank you all. You kept my eye on the target and made me take the necessary time off to complete the research. I will always be grateful for your unyielding support. Lastly, to my extended family, Debbie and Garry, thanks for all of your love and encouragement. I am ready to get back on the golf course, promise!
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CHAPTER I

INTRODUCTION

Professional or staff development is the term that educators use to describe the continuing education of teachers, administrators, and other school employees. In the past decade, professional development has evolved in content, delivery, and style. The National Science Education Standards promoted instructional approaches that prepare students to take more active roles in their learning and to construct more powerful and flexible knowledge and understanding (National Research Council [NRC], 1996). These science standards also emphasized that reforming science education requires changes in how science is taught. For these changes to occur, a different approach is needed in professional development practices and pre-service teacher training. Unfortunately, in most districts, professional development is thought of in terms of formal educational activities. Most schools hold a half- or full-day program that may or may not be relevant to the teachers’ professional growth needs. These programs may feature experts who speak to all teachers on a general topic or feature a hit-or-miss workshop that addresses general principles of classroom management, one general instructional method, or the use of audiovisual equipment. Teachers typically spend a few hours listening and leave with
some practical tips or one useful idea. There is seldom any follow-up to the experience, and subsequent sessions may address entirely different topics (Guskey, 2000).

Professional development sessions are a prevalent means of teacher learning in American schools. In several areas teacher participation has been required by states for re-certification and contract renewal. Meaningful staff development is needed to keep teachers abreast of the latest techniques and concepts essential in preparing youth for the 21st century. Darling-Hammond (1997) asserted that to meet the needs of the 21st century, America’s teachers will have to teach vastly different learners to master more complex skills and more challenging content. To improve education, professional development must be improved. A random selection of hit-or-miss courses and one-time consultants cannot continue to provide teachers with the knowledge and teaching techniques to bring all students to high standards (Sparks & Hirsh, 2000a).

Evaluation of professional development is seldom accomplished. Many leading educators have advocated that the ultimate goal of professional development is to contribute to improved classroom practices and ultimately higher student achievement. However, to understand if these objectives occur, evaluation is the key. In this age of accountability, as students are expected to meet higher standards, professional development is very important (Guskey, 1998). Equally important is making certain the professional development accomplishes what it sets out to do. In his book *Evaluating Professional Development*, Guskey (2000) suggested that well-designed evaluations are valuable learning tools that can guide the content, form, and structure of future professional development.
Background of Subject Area Testing and Accountability in Mississippi

For over 30 years, Mississippi has been strengthening student assessment and accountability standards in an effort to raise student achievement (Mississippi Department of Education [MDE], 2004). In 1982 the Mississippi Education Reform Act called for an organized system of assessment and accountability in Mississippi schools (MDE, 2003a). Legislation enacted in 1994 maintained the emphasis on student achievement and mandated that the Mississippi State Board of Education strengthen and expand the performance-based accreditation system. The 1994 legislation initiated the Subject Area Testing Program in Mississippi (MDE, 2004). Subject area tests, used as end-of-course assessments, were initially developed in Algebra I, Biology I, and United States History from 1977. These tests were initially based on testing objectives developed from the Mississippi frameworks by the testing contractor, Harcourt Assessment, Inc. (V. Malone, personal communication, June 21, 2001). The Mississippi Legislature passed the Mississippi Student Achievement Improvement Act of 1999, Senate Bill 2156 (MDE, 2004). The act required the State Board of Education to implement a performance-based accreditation system for both individual schools and school districts. This legislation also required that annual performance standards be set for each school in the state and the performance of each school be measured against itself, using student growth and performance measures (MDE, 2003b). The 1999 legislation required that new subject area tests be constructed based on the Mississippi frameworks and also added an English II assessment to the other end-of-course tests (MDE, 2003c).
The Mississippi School Accountability Model, Senate Bill 2488, was passed during the 2000 Mississippi Legislative Session (MDE, 2003a). This legislation required that school accreditation levels be based on two criteria: (a) an annual growth expectation in student achievement, and (b) the percentage of students proficient at grade level (MDE, 2003b). In 2000 the Mississippi Board of Education revised graduation requirements (MDE, 2003c). The graduation requirements shifted from the successful passing of the Functional Literacy Exam to making successful scores on the four subject area tests. New tests were developed from the revised subject frameworks that also aligned with national standards in each area. Beginning in the 2001–2002 school year, students were required to pass the subject-area tests as a requirement for graduation. Students have continued to be assessed on the content at the completion of the course in Algebra I, Biology I, English II, and U. S. History from 1877 (Harcourt Assessment, Inc. [HAI], 2004).

Under the direction of the Mississippi Department of Education, teacher committees composed of Mississippi educators used the Mississippi Curriculum Frameworks to determine the content to be assessed and the types of questions to be included (HAI, 2004). After the content was determined, each subject-area teacher committee developed a blueprint showing the areas to be assessed, number of items in each area, and types of items to be used to test the strands (MDE, 2003c). Test items include multiple-choice questions and open-ended questions that require students to respond in writing. The English II writing component requires the students to respond to two types of writing prompts (HAI, 2004).
In the Mississippi School Accountability model, the school performance classification is based on data gathered from student testing. Testing takes place for students in grades 2–8 in the spring of each year on reading, language, and mathematics. At the secondary school level, the subject areas of Algebra I, Biology I, English II, and U. S. History are assessed (MDE, 2003a). In the new accreditation model, public school accreditation is two-fold: Each school district is awarded an accreditation status based on compliance with process standards, and individual schools are assigned a performance level based on student achievement (MDE, 2004). The school-performance classifications can be assigned as follows: Level 1 (Low-Achieving), where the school failed to meet its growth expectation and is in achievement at Level 1; Level 2 (Under-Achieving), where the school failed to meet growth and is in achievement Level 2; Level 3 (Successful), where the school met its growth expectations or failed to meet growth and is in achievement Level 3; Level 4 (Exemplary), where the school is in achievement Level 4 or exceeded growth expectations and is in achievement Level 3; and Level 5 (Superior-Performing) where the school is in achievement Level 5 (MDE, 2003a).

With the sweeping changes in the state’s accountability and assessment systems, school districts across the state need assistance in understanding the new requirements and policies. The Mississippi Department of Education (MDE) can provide only limited assistance to each school district at the elementary-, middle-, and high-school levels (V. Anderson, personal communication, July 22, 2002). The MDE has published *The Mississippi Biology I Intervention Guide* to help biology teachers evaluate the
deficiencies of each student by assessment strands (MDE, 2003c). The guide also provided sample teaching strategies and assessment items on each competency and objective from the 2001 *Mississippi Science Framework*. Harcourt Assessment, Inc., contractor for the Biology I Subject Area Test, has provided a one-day workshop each year to detail how items are formulated, how the test is constructed, and how the tests are scored (J. Kirkland, personal communication, September 21, 2001). Often one general teaching strategy is included in this one-day workshop for each subject area. However, these limited professional-development opportunities are often not enough in helping teachers plan instruction to meet the challenges set forth by the new assessment and accountability models.

**Background of PREPS**

The Program for Research and Evaluation for Public Schools, Inc. (PREPS) was organized in 1976 as a special program of the Bureau of Educational Research and Evaluation in the College of Education of Mississippi State University (Satterfiel, 1977). The initial purpose of PREPS was to help public school districts by providing technical assistance and analyzing data so sound curricular and administrative decisions could be made. Fourteen public school districts participated in the original PREPS consortium. Today PREPS is part of a larger Center for Educational Partnerships, which was established by the College of Education in 1996 (PREPS, 2004). PREPS is a private nonprofit consortium of school districts across the state of Mississippi. PREPS provides many services to its districts, including providing instructional-program evaluations,
curriculum materials, instructional techniques, classroom-management strategies, and guidance in overall program and facility planning (PREPS, 1998).

Today the mission of PREPS is “to promote growth of the whole educator and the whole student through educational partnerships across Mississippi” (PREPS, 2004, Goals and Mission, ¶1). PREPS has a 2003–2004 membership of 99 school districts, which represent approximately 300,700 students and 21,010 instructional personnel. The various programs PREPS offers member districts include an instructional-program evaluation process tailored to assist districts in aligning district-specific curricula with state and national content frameworks; an integrated assessment workshop series where trainers deliver curricular materials, instructional techniques, and assessment items into teaching units consistent with the objectives of statewide language-arts and math frameworks for grades 2-9; and a leadership service to provide member districts with the latest information on state accreditation, reading initiatives, and crisis management. PREPS also guides districts in school program and facility planning such that these two components of schools and districts are understood to be inseparable parts of quality education.

In 1998 PREPS contracted with another Center for Educational Partnerships service, The Mississippi Writing/Thinking Institute (MWTI), to design a Subject Area Training Module to assist member districts in improving performance on state assessments in Algebra I, Biology I, and United States History (Bridges, 2001). The Subject Area Module is designed to directly address the content, objectives, teaching
strategies, and assessment techniques used in classrooms that have been successful in improving scores on Subject Area assessments. The development team has created curricular pieces and units of study in each subject area that can assist students in mastering objectives from the state frameworks. These units are designed to serve as models for teachers to use in developing other units to use in their classrooms. The overall goals of the PREPS Subject Area Module are to help align curriculum, instruction and assessment in Algebra I, English II, Biology I, and U.S. History classrooms and to provide teachers with curricular pieces, teaching strategies, and assessment techniques that will assist students in mastering objectives of state frameworks and assessment objectives (PREPS, 2004).

The second integral part of the project is the design of five-day professional-development sessions. During the sessions, teacher-presenters model effective teaching strategies to use in each subject area. The sessions are designed so the teacher-participants experience the teaching strategies as students in a simulated classroom setting. The presenters lead debriefing discussions with participants so they understand the underlying theory and reasoning of each strategy. Each subject-area session is designed so the participants can recognize that the subject-area tests are not tests of recall but of thinking and application. Each presentation includes emphasis on the role that reading, writing, and higher-order-thinking skills play in each subject and on each subject-area test. Between sessions teachers implement strategies and teaching units and return to share experiences and make adjustments in their teaching practices (T. Bridges, personal communication, July 7, 2000).
Assessment is emphasized during one day of the training. Teachers learn about rubrics similar to those used to score open-ended items on the subject-area tests. They actually read and score student anchor papers and develop strategies for improving student writing on such items. The presenter also leads the teachers in developing their own open-response items for weekly classroom assessments, as well as enhanced multiple-choice items similar to those found on the actual subject-area tests. The use of alternative assessments is also demonstrated and discussed during the workshop (PREPS, 2004).

The MWTI took the responsibility of not only developing the teaching materials, but also of providing an assessment coordinator from 1998–2000 who made sure all of the Subject Area Test Modules were effectively designed, updated where needed, and scheduled as closely as possible according to the original design. This assessment coordinator made sure the teachers were registered, notified of the acceptance into the training, and provided with Continuing Education Units (CEU). Appropriate sign-in sheets, supplies, evaluation forms, and follow-up materials were provided at each site under the direction of this coordinator (T. Bridges, personal communication, July 7, 2000). The assessment coordinator for the MWTI took another position in the fall of 2000, and MWTI did not fill this vacated position. Instead, the workshops came under the direction of a graduate student who worked part time for the MWTI (K. Patterson, personal communication, June 10, 2001). PREPS eventually took total control of the workshop coordination, presentations, and scheduling in the fall of 2002 (C. Ward, personal communication, February 20, 2003).
The Biology I Subject Area Module was designed to provide teachers with curriculum pieces, teaching strategies and assessment techniques to assist students in mastering objectives of the *Mississippi Science Framework* and the Biology I Subject Area Test (PREPS, 2004). The original training module in Biology I began as a five-day workshop. It also has been modified and presented in a four-day format for districts that did not want teachers away from the classroom for five days. The original design will be used to describe the format for this study.

The ideal schedule for the professional development is for days one and two to be scheduled before school begins. Days three and four are scheduled around mid-term and day five is scheduled one month before the Mississippi Biology I Subject Area Test is given in the spring. This design basically broadens the training over a year period. Teachers are able to try techniques in their classrooms and bring back success stories or problems to share during the next sessions (T. Bridges, personal communication, July 7, 2000). New approaches are discussed to strengthen each teacher’s professional learning using this model.

The Biology I sessions are designed to introduce teachers to new teaching styles and techniques that have proven successful in improving scores on the Biology I Subject Area Test (PREPS, 2004). Days one and two are dedicated to an experimental design and graphing unit. This unit corresponds with the all objectives found in the Nature of Science assessment strand comprising 21% of the Biology I Subject Area Test (Malone, 2000). Day one of the training emphasized problem solving. Teachers work through
simple experiments that teach students the basics of designing experiments using the scientific method. Reading strategies, thinking skills, observation skills, and brainstorming in cooperative-learning groups are demonstrated for classroom use (PREPS, 1999). Graphing techniques are emphasized on day two. Teachers are led through the basics of constructing line and bar graphs. The teachers perform two experiments using simple household items to collect data for constructing graphs. Teachers are given sample ideas of how experimental designs and graphing can be used in different units throughout the entire Biology I course (PREPS, 1999). At the end of the first two days, the teachers are asked to go back to their classrooms to teach the unit, including the reading strategies, thinking skills, and observation skills, to their students. They are asked to write down reflections, successes and problems encountered, for discussion on day three (T. Bridges, personal communication, July 7, 2000).

Day three begins with follow-up discussions of the experimental design and graphing unit. After the teachers share experiences, they begin learning about methods of classroom assessment. Teachers are led through a discussion of the rubrics for scoring open-ended test items. They then score sample open-ended test items to become more familiar with the scoring process. Teachers are trained in developing better multiple-choice questions, enhanced multiple-choice questions, and open-response questions for student practice in their own classrooms (PREPS, 1999). The teachers are encouraged to develop a few test items that model the type of items found on the subject area test and to use those items on their weekly tests. This method was recently used in a small rural middle school in Pocomoke, Maryland. The school designed classroom improvement
plans emphasizing active learning with assessments that mirrored the state performance assessment tasks. The school has made steady increases over the past three years in the students’ test scores (Haines, 2001). The PREPS workshop advocated that the practice items will also help the students become familiar with the structure of the test and, therefore, reduce the fear the assessment (T. Bridges, personal communication, July 7, 2000).

Day four was ideally scheduled to immediately follow day three. Teachers are given a sample unit for teaching mitosis and meiosis, a complex subject in Biology I. Mitosis and meiosis are only two of eight objectives in The Cell assessment strand. The Cell assessment strand contains eight objectives and comprises 21% of the Biology I Subject Area Test (Malone, 2000). Classroom activities, simulations, and tools are explored and sample evaluations are discussed. The day ends with teachers being given the assignment of taking the assessment and cell activities into their classrooms for implementation (PREPS, 1999). Again, they should bring back reflections of successes and problems encountered to be discussed in the last day of the training.

Day five is the last day of the workshop series. Teachers begin the day sharing reflections on all strategies learned during the workshops and stories of how they have used the ideas in their classrooms. After the teachers compose charts of what worked and what did not, they are given approximately 20 minutes to read an article. The workshop leaders have carefully selected professional articles, which detail biological teaching, curriculum development, and technology use, from current journals (PREPS, 1999). At
the end of the reading period, the teachers briefly discuss the articles. The importance of professional reading as a means of keeping current in teaching techniques is emphasized. The curriculum piece for day five utilized teachers working in cooperative-learning groups to design an ecology unit similar to the design of the experimental design unit and/or the cell unit. A packet of suggestions on unit writing, along with several innovative classroom activities in ecology, is provided (PREPS, 1999). At the end of the day, teachers are given a copy of the *Biology I Review Guide*. This guide is designed as a brief summary of the most important biological concepts that are included on the Biology I Subject Area Test (T. Bridges, personal communication, July 7, 2000).

The workshop also included the presenter’s modeling effective practices in using reading strategies, as well as tips to make students analyze key points in biological principles. The teachers are actually led through the process just as they would implement the strategies in their own classrooms. Donovan, Sousa, and Walberg (1987) noted that two elements of good staff-development implementation programs include having teachers observe modeling of demonstrations of effective practice as well as giving teachers the opportunity to practice what they had seen in protected conditions. Firestone (1993) added that if more than a few teachers are to emulate new approaches to teaching, staff development that models active learning is a must.

**Purpose of the Study**

Professional development offers opportunities for teachers to reflect on their practices, modify and implement changes in the classroom, and ultimately impact
students’ learning. However, professional development must be evaluated to see whether the desired results are actually occurring in the classroom. Murphy (2000) suggested that unless attention is paid to what occurs after the workshops, the best-designed staff development will not impact the teachers and students.

The purpose of this study was to evaluate the PREPS Biology I Subject Area workshops using Guskey’s evaluation model as a guide for the process. Since the initial workshop evaluations were collected at the end of the workshops, no follow-up or contact with the teacher participants had been conducted. The initial evaluation forms filled out at the end of the workshops comply with Guskey’s first level of evaluation. This instrument measured the participants’ reactions to the workshop material, presentation, and setting by using rating scales and open-ended questions (Guskey, 2000).

The goal of this study was to use the initial evaluations and also to further investigate the teachers’ knowledge, skills, organization structure, and implementation of the workshop materials and strategies. Student achievement was explored as perceived by the teacher for successful classroom experiences and assessment gains. Guskey’s levels two, three, four, and five of professional development evaluation were used for this process.

**Research Questions**

The study will address the following research questions:

1. How did the participants rate the effectiveness of the PREPS Biology I workshop?
2. To what extent did the participants acquire the intended knowledge and skills presented in the PREPS Biology I workshop?
3. What organizational characteristics and structures were in place to support teacher change in the schools of the participants in the PREPS Biology I workshops?

4. To what extent did the participants in the Biology I workshop use the units and strategies in their classroom?

5. Did the teaching strategies and classroom units affect student performance or achievement?

**Rationale for Study**

Professional and staff development programs are intended to equip teachers with new skills and techniques for achieving better results for students (Shaha, Lewis, O’Donnell, & Brown, 2004). However, very few programs provide any data showing the effects on teachers and students. Professional development’s impact on teachers, students, and schools is usually not documented. Evaluations of professional development have typically been an overlooked component of the process (Kuter, Sherman, Tibbetts, & Condelli, 1997). Today’s school districts no longer have the luxury of supporting unexamined professional-development activities. With No Child Left Behind legislation enacted, the pressure is high to find ways to support successful teaching and learning through effective professional development. Today, in the age of accountability, expenditures must represent investments that promise some improvements in teacher and student performance (Guskey, 2002a). To determine if there is evidence of teacher implementation and student successes, evaluations must be incorporated within the professional-development process (Kuter et al., 1997). The recent importance placed on professional development as an answer to meeting new standards is not just a national phenomenon. In 1994 the Mississippi Subject Area Testing Program (MSATP) was
designed to provide information regarding the effectiveness of instructional programs and to furnish results that are used in the performance-based accreditation system (MDE, 2004). The test instruments are developed based on the Mississippi Subject Frameworks and national standards in each subject area. In 2000 legislation that ties the MSATP to high school graduation standards was passed (MDE 2003c). New tests were developed in four areas, Algebra I, Biology I, English II, and U.S. History from 1877, to meet the intent of this legislation. Harcourt Assessment, Inc., the test contractor working with MDE, provides a one-day professional development on the general design of these tests (V. Malone, personal communication, June 21, 2001). However, given the new high-stakes testing program, one-day overviews with the teachers are not enough to ensure student achievement. Abdal-Haqq (1996) identified several factors essential in delivering effective professional-development programs: providing training practice and time for reflection, allowing opportunity for group sharing, focusing on student learning, and providing follow-up support. School districts need effective staff-development programs to help teachers remain up-to-date with trends in national standards and changes on the state level. Science teachers also need current information on how the publication of the National Science Education Standards has changed curriculum and instructional practices across the nation.

The PREPS Biology I Subject Area Module is designed to meet recommendations emphasized in the National Science Education Standards for effective professional-development training. It is designed to provide teachers with curriculum pieces, teaching strategies, and assessment techniques that will assist students in mastering objectives in
the *Mississippi Science Framework* and the Biology I Subject Area Test (PREPS, 2004). If research indicates that the professional development series helps produce positive changes in the biology classroom, this module could serve as a model for other professional-development programs to help teachers assist Mississippi students achieve the highest standards in their academic endeavors.

**Limitations of the Study**

This study focused on the teachers from the 99 school districts that are members of the PREPS consortium. The schools in the PREPS districts represent a range of sizes, represent urban to rural schools, and also represent a variety of accreditation levels. The teachers in the PREPS districts are located across the state of Mississippi. However, this study is limited in the fact that only the PREPS members had access to this workshop series during the time of the study; it was not offered to all school districts across the state.

Another limitation in the study is the exclusion of the teachers who participated in the workshop during the school years beginning in 2001–2002 to the present. After PREPS took over the workshop coordination, presentations, and scheduling in the spring of 2002, the Final Evaluation Forms changed drastically from the original forms developed by the Mississippi Writing/Thinking Institute (MWTI). The scheduling of the workshops was very different after the MWTI assessment coordinator left the project in the fall of 2000. Because comparing data from the workshop series offered prior to the 2001–2002 school year to those offered after the 2001–2002 school year would be difficult, the researcher decided to limit the study to only those teachers who attended the
workshop prior to school year 2001–2002. Further study should be done to evaluate the series after the 2001–2002 school year.
CHAPTER II

REVIEW OF THE LITERATURE

Background

For the past two decades, school-reform movements have focused on the classroom to improve the quality of K-12 education. In April 1983, the National Commission on Excellence in Education (1983) released the well-known report *A Nation at Risk*. The report presented data based on four major educational topics: content, expectations, time, and teaching. The report listed seven recommendations for improving teaching. One of these recommendations proposed that teachers spend more time on curriculum and professional development. *A Nation at Risk* advocated that teaching practices be aligned with student performance. Numerous articles and studies immediately followed to publicize the best approaches to ensure high teacher quality and high classroom standards. Continued efforts to reform the nation’s schools still seek to develop a wide variety of practices that support teacher learning, as well as student learning (Lieberman, 1995). Crates (1977) advocated that teaching and learning practices should be aligned with standards and outcomes. According to Gibbons, Kimmel, and O’Shea (1997), the curriculum frameworks have been prepared, but schools need the new teaching behaviors that will assure achievement of content standards. Goldenberg and
Gallimore (1991) added if educators are to achieve the goals of the new frameworks and standards, important changes in teaching practices will be required.

With the publication of the *National Science Education Standards* in March 1996, schools and teachers across the country revisited the need to reform science education. According to the *National Science Education Standards*, the most direct route to improving science achievement for all students is through better science teaching (Sutton & Krueger, 2001). Quality teaching practices need to be aligned with what students should know and be able to do. The *Standards* address a vision for science education that included science teaching standards, standards for professional development for teachers of science, assessments in science education, science education program standards, and science education system standards (NRC, 1996). According to Sutton and Krueger (2001), the three components that influence student learning are the teacher’s background and knowledge, professional development, and classroom practices. Professional development tailored to increase the teacher’s content knowledge and classroom practices supports high student academic performance.

Educators and school policymakers are now addressing the No Child Left Behind Act, signed into law in January 2002. This law has been described as “the most sweeping education reform legislation in decades” (Cicchinelli, Gaddy, Lefkowits, & Miller, 2003, ¶ 1). At the core of the No Child Left Behind Act were a number of measures designed to drive broad gains in student achievement and to hold states and schools more accountable for student progress (The White House, n.d.). The law emphasized accountability in schools as measured by student achievement. Teacher qualifications
were characterized to assure that every teacher is certified to teach with subject-matter competence. (No child left behind, n.d.). This mandate has led schools to provide professional development that strengthens the capacities of both new and veteran teachers. According to Cicchineli et al. (2003), policymakers and educators need to emphasize research-based instructional strategies to improve teachers’ pedagogy and skill through professional development.

Because of the emphasis on school improvement, school districts and state education agencies are continuously evaluating test scores to determine what students are learning, where schools are failing, and how schools need to work differently (National Educational Foundation [NEF], 2003). In the report *How Teaching Matters: Bringing the Classroom Back Into Discussion of Teacher Quality*, results of a nationwide study have shown that teacher input, professional development, and classroom practices all influence student achievement. However, the study concluded that the highest academic performance of students is linked to classroom practices of teachers who have been trained through quality professional development (Wenglinsky, 2000). Sparks and Hirsh (2000a) described research that shows improving teacher knowledge and teaching skills is essential to raising student performance. A 1998 study by Cohen and Hill (as cited in Sparks & Hirsh, 2000a) found a positive relationship between teacher participation in long-term curriculum workshops and students’ scores on California’s state assessment. The professional-development activities linked the curriculum, classroom teaching practices, and classroom assessment practices. Darling-Hammond (1998) took this one
step further and added that teachers should not only be aware of research between classroom practices and student achievement, but they also should investigate the effects of their own teaching on students’ learning.

To improve student education, the nation must improve professional development practices. American schools can no longer hope that a random selection of courses and consultants will provide teachers with the knowledge and techniques to improve instruction (Sparks & Hirsh, 2000a). Brennen (2001) defined improvement of instruction as the teacher’s acquisition of the most effective and up-to-date teaching methods. Darling-Hammond (1998) listed four areas of what teachers need to know to help children meet today’s standards. She advocated that teachers need to understand subject matter, use different teaching strategies to accomplish various classroom goals, know about curriculum resources and technologies to further student learning, and be able to analyze and reflect on the effects of their teaching to refine instruction. The National Science Education Standards stated:

becoming an effective science teacher is a continuous, lifelong process. The challenge of professional development…is to create optimal collaborative learning situations in which the best sources of expertise are linked with the experiences and current needs of the teachers. (NRC, 1996, p. 58)

Science education, especially biology education, should be aware of these needs. Dougherty and Miller (1998) recognized that advances in many biological disciplines seen on the front pages of newspapers have confronted us with issues undreamed of even 20 years ago. Teachers must rise to the challenge of educating youth to the current advances in science and other disciplines. Meaningful professional development is
needed to keep teachers abreast of the latest techniques and concepts that will prepare youth for the 21st century.

**Limitations of Professional Development**

Despite almost two decades of reform talk, research has shown that very little change is actually happening in the classroom. A recent study published from the National Center for Education Statistics reported that only 56 percent of teachers are using instructional strategies aligned with high standards (Sparks & Hirsh, 2000a). America’s recent push to reform schools has created high standards, rigorous tests, and strict accountability measures in the hopes that education would also improve. Smith (1996) noted that printed versions of the national standards or a state framework could not transform teaching even if teaching ideas are recommended in the document. Before determining steps to improve and plan effective professional development, educators should analyze what is wrong with the current models. Research has shown that past staff development efforts have focused on such isolated instructional behaviors as utilizing cooperative learning, teaching to learning styles, or using classroom management skills (Gibbons et al., 1997). Typically, professional development has attracted the smallest percentage of the school budget (Brennen, 2001). Levinson and Grohe (2002) accurately described many teachers’ experiences as Wednesday-afternoon presentations by mediocre presenters, five-times-a-year workshops on days that the students stay home, or university courses that are not linked to effective teaching. The following paragraphs describe four major shortcomings in the past models of professional development.
Lack of Knowledge about Teacher Learning

Professional development has been limited by a lack of knowledge about how teachers learn. Most staff development has attempted to indoctrinate teachers by force-feeding them, while warning them that force-feeding their students is undesirable (Lieberman, 1995). Hirsh (2002) described a scenario where a school district mandated one-day training on constructivist teaching. The teachers were presented a list of characteristics of constructivist classrooms and at the end of the day were expected to go try out this new idea. Hirsh concluded that a district committed to this instructional model would provide teachers with opportunities to construct their own knowledge rather than receive it from trainers in pre-digested packages. Lieberman (1995) reminded that learning theorists agree that people learn best through active involvement in the process just as the students do. Teachers are often treated by state and national reformers as passive learners. They are the mere recipients of curriculum standards, new frameworks, and instructional improvements. However, the same reformers expected the teachers to create learning communities in which students actively build knowledge, analyze and solve problems, cooperate on challenging projects, and debate what they read (Smith, 1996). Brennen (2001) found that teachers often feel that professional development activities do not match their cognitive, social, and emotional characteristics. Instead, they preferred learning situations that integrated new ideas with existing knowledge and that allowed choice and self-direction (Darling-Hammond, 1998).
Lack of Context Characteristics

A second limitation involves the context within which the teachers work. Context is the organization, system, or culture in which the professional-development strategies will be implemented (Guskey & Sparks, 1996). Teachers often work in isolation; the sharing of ideas or lessons is rare and not encouraged in most settings (Roychoudhry & Kahle, 1999). According to Darling-Hammond and McLaughlin (1995), “almost everything about school is oriented toward going it alone professionally . . . . Few schools are structured to allow teachers to think in terms of shared problems or broader organizational goals” (p. 601). Often teachers lack administrative support to work together with others. Sparks and Hirsh (1997) reported that many times when a teacher learns a new instructional skill, the teacher will not use it due to the fact that no one else in the school is using it and the principal does not support the practice.

Related to school context is the planning of professional-development practices. Murphy (2002) contended that most of the time principals plan staff-development programs that are intended to achieve dramatic improvements in classroom teaching. The problem is that in many cases what the teachers learn has little relationship to actual practice. Lieberman (1995) asserted that most of the in-service training that the teachers are exposed to is unconnected to classroom life and is often a combination of abstract ideas that pay little attention to the ongoing support of continuous learning and changed practices. Often teachers are mandated by district and state requirements to take university courses to maintain the teachers’ professional licenses. Sparks and Hirsh
(2000a) reported that a school’s professional-development programs often require teachers to take miscellaneous education courses that are not necessarily linked to the school’s plans or the students’ needs. Most of the time, the teachers collected course credit without ever being exposed to anything that would change their instruction. On the other end of the spectrum are the schools that buy elaborate programs but do not provide the means of implementation. Killion (2000) told a story of a district that adopted new curriculum materials to improve student achievement in reading but failed to provide opportunities for teachers to learn to use and understand the materials. In this case the school district focused on the materials and ignored the teachers and the students.

**Lack of Time**

A third limitation is professional-development planning involving time. Most schools design staff development for one afternoon a week or during a single day when students are allowed to stay at home (Levinson & Grohe, 2002). This design is lacking a very important factor for learning—adequate time. “Just as traditional school organization isolates teachers, so, too, is it stingy with time for working and learning together” (WestEd, 2000, p. 32). Well-designed professional development is a key to success because teachers do not have time to waste. According to Haycock and Robinson (2001), there are so few professional development hours available. When one hour is spent on something impractical, a serious problem exists. The common practices in staff development, such as single-topic workshops or infrequently scheduled curriculum planning days, would need to be enhanced if teachers are to receive the education and training recommended in the national standards (Gibbons et al., 1997). The greatest
challenge, according to Abdal-Haqq (1996), in implementing effective professional
development is lack of time. Because time is the biggest barrier to school change,
rethinking and restructuring time is central to building a learning culture (WestEd, 2000).
Guskey and Sparks (1996) stressed that critiquing and refining classroom practices is a
complex procedure and requires considerable time. According to Sparks and Hirsh
(2000a), even the teachers who initially received an outstanding pre-service teacher
education still need additional quality staff development.

Lack of Follow-up and Evaluation

A last limitation of current professional development activities involves the lack
of follow up and proper evaluation. Many times teachers attend a conference or
workshop on a topic that relates to the subjects that they teach. The teachers intend to go
home and use the materials and knowledge gained, but often the new practices are never
implemented (Richardson, 1999b). Joyce and Showers’ research (as cited in Richardson,
2003) over 20 years ago reported that initial learning would be lost unless a structured
follow-up program was included. This follow up could be an additional workshop,
conversations with administrators, or sharing results with peers. According to Darling-
Hammond and McLaughlin (1995), teachers must share what they have learned in
professional development and discuss what they want to learn in a cooperative experience
with their peers. Initial workshop quality may be lacking if evaluations are not included.
Past workshops have an evaluation form at the end of the day to measure the teacher’s
reaction to the material presented. This method only provided for teacher satisfaction and
often lacked follow-up assessment of any new teaching behavior after completed.
According to Gibbons et al., (1997), the design, implementation and evaluation of successful staff-development programs must accompany the workshops to ensure the new teacher behaviors are being implemented in the classrooms. Fleming (1966) advocated that professional development designers and school districts provide opportunities for teachers to practice the methods demonstrated, give feedback on the new methods, and help the teachers apply their new knowledge in the classroom.

**Factors of Effective Professional Development**

The National Staff Development Council (NSDC) released a revised set of standards for staff development in 2001 (National Staff Development Council [NSCD], 2001). According to Mizell (2001), the NSDC standards represented a road map to high-quality staff development. These standards are organized into three major categories: context, content, and process. Context standards are professional-development goals that furnish resources to support adult learning, provide school and district leaders who guide continuous instructional improvement, and organize adults into learning communities whose goals are aligned with those of the school and the district. Content standards are based in deepening the educators’ content knowledge and providing them with research-based instructional and assessment strategies to assist students in meeting rigorous academic standards. Another content goal was to prepare educators to understand student learning and hold high expectations for students’ academic achievement. The last area is the process standards. These standards involved using data-driven research to plan classroom instruction and using learning strategies appropriate to the intended goal. Another process standard was to design staff development that involved applying
knowledge about human learning and change. Educators should also be provided with the knowledge and skills to collaborate. A last process standard involved using multiple sources of information to guide improvement and demonstrate its impact (NSDC, 2001). The factors of effective professional development in this section are organized according to the National Staff Development Council’s standards. Each component of the three basic standards has detailed supporting evidence from the literature.

**Context Standards**

All researchers agree that effective professional development must be continuous and ongoing throughout the professional teacher’s career (Abdal-Haqq, 1996, Darling-Hammond, 1998, Guskey, 1998, Holloway, 2003). This element is part of providing the resources to support adult learning. Goldenberg and Gallimore (1991) asserted that to genuinely improve teaching, educators must say goodbye to quick-fix workshops and hello to staff development that provides intellectual stimulation and opportunities to develop new knowledge and skills. The current model of squeezing in a professional-development session after school or in a one-day workshop should be discarded. Longer sessions give teachers a chance to plan how they can use what they learn within the framework of their own classroom goals and their district’s goals (Time is key, 2002). This article also stressed that scheduling workshops over time allows more opportunities to delve into academic content. According to Bradley (1996), schools must rethink the use of time. She added that in America teachers spend all of their time with students, unlike Japanese, Chinese, and most European teachers. In these countries, teachers have substantial time built into their regular workday for preparation, curriculum development,
and planning with colleagues. Schools should create a culture of continual professional development in which the teachers expect to study some aspect of practice. In the article “Rethinking Professional Development,” the authors advocated giving teachers time to reflect and learn together the expected behavior (Rethinking, 1996). The article pointed out that teachers need time to study their own practices and to confer with colleagues to implement new behaviors. Teachers need time to review curriculum plans, instructional techniques, and student assessment practices (Rethinking, 1996). Guskey (2002) noted that when learning a new way of doing things, the teachers need both time and effort.

The time factor also gives teachers the needed opportunities to practice and reflect on new learning situations. For truly effective professional development, teachers should also make changes and develop new approaches that work for them. Teachers need the opportunity to try new instructional strategies, observe what worked and what did not, and then talk with colleagues about solving any problems to the new approach (Shepard, 1995). Radford’s (1997) research evaluated Project Laboratory Investigations and Field Experiences (LIFE), a program for middle- and high-school life science teachers. A variety of assessment instruments have shown that teachers’ science process skills and knowledge of science content have improved after experiencing the project. The students of these teachers also had greater science process skills and better attitudes toward science as compared to students of non-participating teachers. Strategies in the program included asking the teachers to reflect on what they were learning and plan ways to integrate the content and teaching methods into their teaching. They were asked how they might modify a strategy to meet the needs of their students better. Lastly, they were
given feedback about their implementation during follow-up visits from the project coordinator and during follow-up sessions with others in the project. Stiles and Loucks-Horsley (1998) suggested that to learn most from a unit of instruction, teachers need opportunities to discuss how well the units worked, how the students reacted, and what they might do differently with their own teaching and curriculum materials. Guskey (2002b) stated that teachers become committed to new practices only after they actively engage in using the new practices. He pointed out that the true change in teacher behaviors would occur after the practices cause positive changes in student learning. Hodges (1996) asserted that the most effective vehicle for classroom improvement is modeled by teachers who actively participate in the new practices, obtain feedback and support from trusted peers, and participate in an on-going practice-feedback model for a period of time after the initial training. Studies have shown that when the staff development is based on this model, student achievement increases. Fleming (1996) also found that research-supported, effective professional development included follow up, personal feedback, and trouble-shooting meetings.

Effective professional development should involve teachers in the identification of learning experiences and enhance teacher leadership in the context of the schools. Administrators and teachers should work together to plot the course for meeting the needs of the students (Mizell, 2001). King and Newman (2000) reported that teachers should have influence over the substance and process of professional development. This approach would give the teachers a connection to specific conditions of the schools and would facilitate a sense of ownership of the entire process. Loucks-Horsley, Stiles, and
Hewson (1996) wrote that the school’s culture should reflect an expectation that teachers will take on a leadership role in school improvement. They recommend that teachers should be key players in shaping their own professional development and not be just targets of one-shot learning opportunities. Bradley (1996) reported that professional development must be better balanced between meeting the needs of individual teachers and advancing the organizational goals of the schools. This situation can be accomplished through utilizing the teachers as leaders for change. If teachers have a real voice in the decisions that affect them the most, the teachers’ ownership of and commitment to the change efforts will strengthen (WestEd, 2000). King and Newman (2000) advocated four factors that influence the professional community. The entire school has to have clear, shared goals for student learning; the school must advocate collaboration and collective responsibility among staff members; a reflective professional inquiry by staff members must exist; and opportunities for teachers to influence the school’s activities and policies must be provided.

The principal has very specific roles in the school having an effective professional development program. The instructional leadership of the principal in developing the vision and mission of the school is crucial for quality education (Zimmerman & May, 2003). Pierce and Hunsaker (1996) said the school’s vision should be related to student outcomes. They also said that principals and teachers should work together to form the mission and the vision of the school. It is the principal’s role to create new policies and structures that can support professional development, ensuring that all teachers have access to the kind of continuous learning that helps students achieve high standards.
(Sparks & Hirsch, 2000a). Guskey (1997) recommended that any barriers between teachers and administrators be removed so they can work as equal partners in school-improvement efforts. School principals have to involve themselves in the teacher learning process. In effective professional development models, the principals took an active part in observing and talking with teachers about the new knowledge and skills (WestEd, 2000). Principals should also secure resources necessary for classroom improvements, including time, money, and external assistance (Zimmerman & May, 2003). The principal should make change truly come about by allowing teachers time to observe one another, collaborate with one another, and effect policy changes (Guskey, 1997). School leaders must create the school culture in which everyone works together in the improvement process (Guskey, 1995). Strong principal leadership was directly related to high quality professional development (Smylie, Allensworth, Greenberg, Harris, & Luppescu, 2001). This study also reported that principals who exercise strong instructional leadership also set high standards and expectations for teaching and student learning. These principals saw professional development as a process and worked closely with teachers to provide support in implementation of new learning strategies that focused on students’ needs.

**Content Standards**

Effective professional development should provide opportunities to enhance teacher content knowledge and skills. Loucks-Horsley et al. (1996) wrote that teachers should always broaden their content knowledge so they can create better learning opportunities for students. The researchers contended that teachers should learn how to
make informed decisions about curriculum content and implementation and integrate a set of learning experiences into a course of study. Wenglinsky (2000) reported that teachers who are more knowledgeable about the subject they teach are also more likely to engage in effective classroom practices. Borko and Putnam (1995) stressed that an important component of teacher professional development is the expansion and elaboration of the content knowledge base. Professional credibility depends on teachers knowing the material they teach students. Yet current understanding of science has changed radically in recent years (Guskey, 2003). According to Sparks and Hirsh (2000), teachers need to master content and use research-based instructional methods to teach content that helps the students master new skills. Kent (2004) asserted that teachers must be provided with staff development to meet their own knowledge and content needs so they can then provide effective instruction to meet the needs of their students. Advanced Placement (AP) teachers are required to go through a two-week training in preparation for teaching AP courses. Teachers have to teach an exact curriculum in AP courses and must prepare the student to take a rigorous examination upon completion of the course for possible college credit. Teachers found that this type of intense preparation is very effective professional development due to the knowledge gained from the successful teachers who delivered the training (The Finance Project, 2004).

Tied closely with teacher content knowledge is teacher pedagogical knowledge. Loucks-Horsley et al. (1996) advocated that effective professional development should strengthen teachers’ knowledge of how children learn. In How Teaching Matters: Bringing the Classroom Beach Into Discussions of Teacher Quality, the study found that
effective professional development is closely linked to classroom practice (Wenglinksy, 2000). The research also has shown that teachers who have been through an effective professional development are better able to teach higher-order thinking skills and engage in other advanced classroom strategies. An example reported in the research noted that science instructors who learned new laboratory skills during professional development sessions and implemented these skills in their classroom elevated student achievement. These teachers’ students scored 44 percent higher than others in the same grade (Wenglinsky, 2000). Guskey (2003) noted that professional development activities should be modeled to emphasize high-quality instruction. Most teachers value practical information that relates to their day-to-day practice and is linked to specific instruction objectives and learning concepts (NEF, 2003). Willis (2002) stated that educators must find ways of learning from their most successful teachers and make sure other teachers have the opportunity to learn from these programs. Kent (2004) added that teachers need concrete, practical suggestions from others in order to understand how to make changes in instruction. She also reminded that the teachers must want to continue to learn about learning and must see themselves as dynamic agents of change to affect student learning.

**Process Standards**

A process standard in successful professional development is the focus on student learning, which should, in part, guide assessment of its effectiveness. Research indicated that teachers are attracted to professional development that helps their students learn (Guskey, 1997). “Professional development centered on student achievement goals is meaningful to teachers, enabling them to base their instructional decisions on evidence of
what students need” (Holloway, 2003, p. 87). Professional development is most effective when it takes an approach to help the teacher utilize scientific knowledge and skills that help students construct a new understanding through experiences that extend and challenge what they already know (Loucks-Horsley et al., 1996). The effect of any classroom change on student performance should be the bottom line of teaching (Norton, 2001). Measures of student learning typically included indicators of student performance and achievement, such as scores from standardized examinations (Guskey, 1998). According to Loucks-Horsley et al., teachers need clear outcomes and assessment of progress that accurately reflects meaningful achievement of their students. Studies have shown that when the teachers increase their ability to translate knowledge into classroom learning, student achievement improves. One example involved the Carroll Independent School District in Southlake, Texas. The school district adopted a staff-development model based on continuous improvement at the individual, campus and district level. For at least five years, test scores continued to rise; and the number of students taking AP classes increased. SAT and ACT scores also continued to rise, as well as scores on the state criterion-referenced tests (Richardson, 1999a). Sparks (2000) presented the results from the United States Department of Education’s (USDOE) National Awards Program for Model Professional Development. Since 1997 the USDOE has recognized schools and school districts that have implemented powerful forms of staff development that show evidence of improved student learning in the areas targeted by the teachers’ professional learning. Richardson (1999a) reported that Norman Public Schools in Norman, Oklahoma increased significantly the percentages of 5th, 8th, and 11th graders
who passed the state performance-based writing, math, and science assessments. These increases are in alignment with the districts’ increased professional-development model for teachers in these areas between 1995 and 1998. School-based staff-development programs should be designed to complement students’ learning needs to ensure that the teachers’ instructional efforts translate into significantly improved student performance. Achieving that goal is directly related to how effectively teachers maintain and demonstrate high expectations and standards for all students (Hodges, 1996).

Another process characteristic of effective professional development is to include teachers as professional, active adult learners. New approaches to professional development viewed teachers less as passive recipients of lectures and more as learners actively engaged in activities that enable them to question and make needed changes in teaching (Thinking, 1996). Loucks-Horsley et al. (1996) suggested that the most effective professional development occurs when instructional methods used to promote learning with adults mirror the methods to be used with students. The researchers stressed that often teachers find themselves unable to teach in the ways that students learn because they have not experienced that type of learning themselves. By giving the teacher hands-on experiences in such areas as scientific inquiry, the teachers would feel more confident in using those strategies with their students. According to Brennen (2001) teachers preferred learning situations that integrate new ideas with existing knowledge and capitalize on their experience. She added that teachers also prefer learning situations that show respect for the individual learner. Wright and Backe (1992) stated that if a school emphasizes exemplary professional and personal growth for its
staff, it will have an exemplary program. Smith (1996) asserted that if expert teachers were treated as true professionals, they would be recognized for the areas of expertise that would hold promise for the entire field of educators. With numerous approaches to professional development, having the appropriate method of delivery for each situation is important. Stiles and Loucks-Horsley (1998) noted that strategies have different purposes for different teachers’ needs. For example, a summer institute might be best suited to helping teachers build knowledge, while a continuous after-school discussion with peers might help the teacher reflect on the students’ learning ability. However, staff development must use effective strategies to achieve goals for the teacher participants. Guskey and Sparks (1996) emphasized that if staff development does not alter teachers’ professional knowledge of their classroom practices, little improvement in student learning can be expected.

Changing teaching practices involves a very complex process that is often difficult to achieve. Darling-Hammond (1997) noted that veteran teachers often feel insecure and discouraged after an intense training that emphasized new standards with very different pedagogies. The new techniques could shake their confidence and sense of efficacy if not approached carefully. Change is made by individuals, is highly personal in nature, and entails developmental growth in feelings and skills (Cook & Fine, 1996). Change involves boosting teacher efficacy. According to Enderlin-Lampe (1997), to enhance their efficacy, teachers must believe that their behaviors can affect the education of their students. Teachers must feel confident in making decisions that will affect their performance and students’ production. Banner (2004) pointed out that teachers should be
bold in their aspirations for their classrooms in order to instill in the students the desire to have high achievement goals. Banner added, “If teachers can’t imagine those possibilities, neither will their students” (p. 52). Fullan (1991) characterized the change process as involving four levels of individual acceptance: active initiation and participation, pressure and support, changes in behavior and beliefs, and ownership. Effective professional development should utilize these characteristics. The design, implementation, and evaluation of professional development must ensure attention to all phases of the change process; otherwise, desired changes may not occur (Cook & Fine, 1996). Cook and Fine also recommended that professional development shift its emphasis from working on teachers to working with teachers toward improvement in teaching and learning for all students.

Effective professional development must allow the teacher to collaborate and interact with peers in the school setting. Hodges (1996) reported on research that shows student improvement when the school develops a shared sense of purposeful direction for goals, including joint work among teachers in planning, seeking potentially better instructional practices, and assessing the practices. Goldenberg and Gallimore (1991) emphasized that teachers must have opportunities to meet with colleagues for an extended period for the explicit purpose of learning new knowledge and skills. King and Newman (2000) wrote that teachers are more likely to learn when they collaborate with professional peers, both within and outside of their schools, and when they gain further expertise through access to external researches and programs. Guskey (2003) reminded that educators at all levels value opportunities to work together, reflect on practices,
exchange ideas, and share strategies. However, he cautioned that collaboration with other professional needs to be structured and purposeful with efforts guided by clear goals for student learning. Having the availability to interact with peers for learning opportunities and to develop creativity is crucial to a teacher’s growth (Brennen, 2001). Stiles and Loucks-Horsley (1998) found that teachers are more successful when they form study groups with their peers. These study groups should be on-going, supported by school and district administrators, linked to the school’s curricula, and assisted by outside experts when needed. Strategies such as these encourage and strongly support teachers as they grow and change how they teach. Hirsh and Sparks (1999) asserted that making change in the classroom require support and pressure from colleagues. If teachers want to meet the standards facing them today, they must constantly learn from each other and gain feedback from colleagues. This learning may be as simple as talking to another teacher over lunch or using on-going professional-development days to plan instruction. When teachers share what works with each other, plan units of instruction and trade ideas about assessments, a powerful tool of professional learning is created (WestEd, 2000).

A last process characteristic of effective professional development is the evaluation process. In the past the effectiveness of professional development programs was often measured by how much people “liked” it (Hirsch & Sparks, 1999). Teachers would fill out a quick evaluation at the end of the session and the session was usually not mentioned again. Fleming (1996) agreed that the days of evaluating using the “smile” sheets are over. Today’s professional development programs must meet higher
standards. If professional development is well designed, is based on the latest research, and meets the goals of the classroom, schools still must determine whether the new learning strategies were used and if they had the desired outcomes. Murphy (2000) advocated that follow-up strategies must be incorporated to see whether teachers use what they have learned in staff development sessions. Evaluation allowed the policy makers and the staff-development directors to make better decisions about staff development, how to strengthen what is not effective, and how to measure the results of their efforts (Killion, 2002). Guskey (2002a) asserted that because education budgets are so tight, schools are beginning to wonder if the money spent on professional development is really worth the investment. He added that professional development should be a purposeful activity. Guskey said, “Through evaluation, you can determine whether these activities are achieving their purposes” (p. 46). Cook and Fine (1997) noted that teacher-improvement programs must be assessed to determine their value to the school, individual educator, and ultimately the students. Educators should evaluate professional development to make the programs the best possible and provide information that others can use to improve similar programs (Weiss, 1999).

Evaluation Characteristics

Professional-development evaluations are important to both the developers and the stakeholders. Formative and summative evaluations are two types of evaluations that are used to meet the needs of both parties. Formative evaluations are used to modify or improve a professional-development program while it is being presented to the teachers.
This type of evaluation can be used daily during a program to ensure that the program is meeting the participants’ needs and expectations (Cook & Fine, 1997). Program developers should be engaged in the process of formative evaluation and should use the results to make adjustments and modifications (Guskey, 1998). Loucks-Horsley et al. (1996) stressed that monitoring teacher experiences in professional-development activities provided opportunities to constantly improve the impact of the activities. Summative evaluation should be done at the conclusion of the program to determine the overall effect of the program (Cook & Fine, 1997). Loucks-Horsley et al. called for an evaluation to measure the longer-term impact on teacher effectiveness, student learning, and school leadership. They asserted that too many resources are invested in professional development not to implement follow-up studies. Cook and Fine reported that summative evaluation should be collected at three levels: educator practices, organizational changes, and student outcomes. They suggested using questionnaires, observations, interviews, and analysis of records to help collect data. Murphy (2000) reminded that unless educators give attention to what happens after the workshop, even the best staff development would not impact teachers and students.

Several articles, briefs and books have been written on the characteristics of what constitutes a good evaluation of professional development. Factors that are necessary and essential are varied. Eldridge (1999) listed several components needed: The evaluations must take place within the context of the school, seek to extrapolate meanings and definitions from the teacher participants, and attempt to uncover how real students in real classrooms are benefiting. Along this theme, Killion (2002) recommended that
evaluators examine the staff development’s impact on student achievement. She added that evaluation efforts should include questions about student achievement and seek evidence that will help determine if the efforts benefited the educators and students. In the publication *Evaluating Professional Development: A Framework for Adult Education*, the authors stressed the importance of allowing sufficient time to pass after the workshop before the evaluation takes place (Kutner et al., 1997). They suggested including procedures to assess the impact of the program on the participants and also to collect data regarding the context within which instruction occurs. Weiss (1999) wrote that assessing the extent to which a project has achieved its goals is important. To accomplish this, evaluators need to look for evidence that teachers have increased their knowledge and skills or improved classroom practices as a result of being involved in the professional development project. The *Standards for Staff Development* of the National Staff Development Council (1994) recommended evaluating (a) teacher reactions to the program, (b) teacher’s learning, (c) teacher’s use of new knowledge and skills, and (d) impact on student assessment. In the critically acclaimed book *Evaluating Professional Development*, Guskey (2000) outlined a series of questions related to evaluating professional development. This book provided a framework for planning and conducting meaningful evaluations. This research utilized the Guskey model for the evaluation of a professional development workshop series. The following section outlines the key questions of the Guskey model.
Guskey’s Model of Evaluating Professional Development

Guskey’s method of evaluating professional development included five stages or levels of information based on a general model advanced by Kirkpatrick in 1959 (Guskey, 2000). Kirkpatrick developed this model for use in business and industry. His model has four levels: reaction, learning, behavior and results. Guskey’s model has five levels that are hierarchical in structure, arranged from simple to more complex. The higher levels build on information gathered at the lower levels. If the researcher was unsuccessful in obtaining answers at lower levels, he/she will not be successful at the higher levels (Guskey, 2000).

The first level of Guskey’s professional development evaluation looked at the participant’s initial reaction to the experience. At this level the questions focused on whether or not the participants liked the experience, if they felt their time was well spent, if the materials made sense to them, if the materials were useful, or if the instructor was knowledgeable and helpful (Guskey, 2002a). Information for this level is generally gathered using questionnaires handed out at the end of the session. The questionnaires should contain a combination of rating-scale questions and open-ended response questions that allow participants to provide personalized comments (Guskey, 2000). Guskey advocated that measuring the initial participant reaction cannot only help with the design and delivery of future programs, but it also serves as a valid prerequisite to higher-level evaluation results.

The second level of Guskey’s professional development evaluation looked at the participant’s learning in the experience. At this level the questions focused on measuring the knowledge and skills that the participants gained (Guskey, 2002a). Each question is
based on the goals and objectives of the program or activity. Information for this level can be gathered using questionnaires, a form of assessment, examination of portfolios that participants assemble, or analysis of case studies (Guskey, 2000). Analysis of this information should provide a basis for improving the content, format, and organization of the program.

The third level of Guskey’s professional development evaluation gathered information on organizational support and change. Organizational variables can be key to the success of using new learning tools or can hinder or prevent success (Guskey, 2000). Questions at this level focused on the organizational structure in terms of whether the program affected the organization climate and procedures, whether the program aligned with the organization’s mission and goals, whether administrative support was available, whether resources to implement the new learning activities were made available, and whether successes were recognized and shared (Guskey, 2002a).

Gathering information for this level is more complex than in the first two levels. It could involve using questionnaires, personal interviews with participants and administrators, and analysis of school and district records or documents.

The fourth level of Guskey’s professional development evaluation looked at the participants’ use of the new knowledge and skills. The central question focused on whether what the participants learned made a difference in their professional practice (Guskey, 2000). This information must be gathered using indicators that reveal both the degree and the quality of implementation of the new practices. However, unlike levels one and two, information at level four cannot be gathered until sufficient time has passed
from the completion of the program. Enough time must have passed to allow participants
to adapt the new ideas and practices to their setting (Guskey, 2002a). Information can be
gathered through the use of questionnaires, interviews, oral or written reflections,
examination of participants’ journals or other documents, or through direct observations.
Analysis of this information could be used to help restructure future programs and to
facilitate better and more consistent implementation (Guskey, 2000).

The fifth level of Guskey’s professional development evaluation looked at the
student learning outcomes. The central question focused on whether the program
benefited students in any way. The measures of student achievement at this level should
be tied to the goals of the program (Guskey, 2000). Information on student learning
could be obtained in various ways. A few examples include grades, standardized test
scores, portfolio evaluations, attendance records, homework completion rates, and
classroom behaviors (Guskey, 2002a). The major source of such information is student
and school records; however, results from questionnaires and structured interviews with
teachers and school officials could also be used (Guskey, 2000). Analysis of level-five
information could guide improvements in all aspects of professional development,
including program design, content, implementation, and follow-up sessions. Guskey
added this information could also be used to estimate whether the professional
development is cost-effective and empowers professional developers to make what they
do count.
Summary

The literature review gave a synopsis of the role professional development has played in recent educational reform movements. Current limitations are identified with support from various researchers. The literature review also included a detailed view of the factors of successful or effective professional development. These factors are organized into context, content, and process standards that were recently published by the National Staff Development Council. One of the last process standards described evaluation. Because this research is an evaluation of a professional development series, this topic is explored in detail as to the types of evaluations and the characteristics of what constitutes a good evaluation. Finally, Guskey’s model of evaluating professional development is described by the five levels that are hierarchical in structure and arranged from simple to more complex.
CHAPTER III

METHOD

This chapter describes the methods used in this research study. The first section describes the design of the study. It also addresses issues of validity and reliability. The second section describes the participants in the study, and the third section describes the instrumentation used to gather data. The fourth section describes the role of the researcher. The final two sections discuss the procedures used in conducting the study and the data analysis used in the study.

Research Design

This summative evaluation study uses a mixed-method design, which combines quantitative and qualitative techniques in conducting and analyzing the research. According to Rocco, Bliss, Gallagher, and Perez-Prado (2003), a researcher should use a research design that is deemed the most appropriate to address the research questions that are asked in the study. This study evaluated a biology teacher workshop series from initial reactions to utilization of the materials and strategies in the teacher’s classrooms. The researcher used quantitative methods to collect from the entire population both initial reactions of participants and their later implementation of the materials from the workshop. The researcher also employed qualitative methods to collect data through
open-ended questions, interviews, and observations. This data provided a detailed view of how each teacher implemented materials and any factors that influenced that use.

The researcher chose a mixed-method design to collect data from large groups, as well as from a few individual cases for the purposes of triangulation and expansion of data. As Green (1997) noted: “Mixed methods have the potential of enabling us to understand more fully, to generate insights that are deeper and broader, and to develop important knowledge claims that respect a wider range of interests and perspectives” (p. 3). The consensus among evaluation experts is that both quantitative and qualitative methods are needed for effective evaluations. Summative evaluations in education are especially enriched by a mixed-method approach (Frechtling, 2002).

The researcher also used case-study research to obtain a more detailed analysis of how and why the teachers used the materials and strategies. The study used a multiple-case design. Yin (1994) advocated the use of case studies in evaluation research. He described five applications using case studies, including using cases to explain and describe the uses of interventions and the real-life context in which the interventions were used. According to Patton (1990), case studies can be used to organize a wide range of information about a study. Seeking patterns and themes in the data collected and finding patterns among the cases further strengthen the overall research design. Yin (1994) stated a key strength of the case-study method involves using multiple sources and techniques in the data-gathering process. Observations and interviews, were used to collect data from the case-study participants.
The purpose of the study was to determine the effectiveness of the PREPS Biology I professional development series by applying the evaluation model developed by Guskey (2000). The design of the research utilized collecting, compiling, and analyzing both quantitative and qualitative data. This general design was patterned after a successful study conducted by Bridges (2001) in her evaluation study of the PREPS English II workshop series. Bridges also used Thomas Guskey’s model as the evaluation format.

**Validity**

Validity addresses whether the research explains or measures what it is intended to measure (Ary, Jacobs, & Razavieh, 1985). The study design must address issues of validity. Yin (1994) discussed types of validity. Construct validity requires the researcher to use the correct measures for the concepts being studied. Yin advocated using multiple types of evidence from multiple sources to help support construct validity. The design of the research is mixed-methods. The researcher collected data and analyzed using a variety of methods. These methods included closed and open-ended questions from surveys, as well as interviews and observations. Collecting data from various sources is also good for triangulation of the data. Denzin and Lincoln (1998) define triangulation as the means that researchers utilize in using different sets of data to study a particular phenomenon. The researcher used triangulation throughout this study in the methods and in the analysis of the data. The use of triangulation increased the validity of the study.
The validity of the instruments in the study can be evaluated by the use of multiple documents backed with interviews and observations. Validity is the extent to which an instrument measures what one thinks it is measuring (Ary et. al., 1985). In this study the two primary instruments had a quantitative section that included the use of rating-scale questions. To ensure these responses are accurate, the instruments also contained an open-response section that allows the respondent to elaborate on the closed items and offers further evidence of accuracy. Interviewing the six case-study participants allowed further data collection that validated the initial evaluation forms and questionnaire responses. Rocco et al. (2003) noted triangulation, which increased a study’s validity, could be achieved by using a qualitative interview and a quantitative questionnaire to assess program participants’ perceptions.

Techniques in the study involving cross-referencing written responses with interview responses help ensure content and construct validity. Glesne (1999) noted that multiple data-collection techniques contribute to the trustworthiness of the data. A final technique to ensure validity in this study was to return transcripts of interviews to the participants for feedback upon completion of the research (Ratcliff, 1999). Yin (1994) advocated sending the draft case-study reports for review by key informants as a tactic to increase construct validity. The researcher sent the interview information to each case-study participant. In addition Dr. Patricia Bridges served as a peer reviewer, reading and analyzing the entire data matrix. Any suggestions, corrections, and elaborations made by the case-study participants or by the peer reviewer were noted. The review and
collaboration with each case study participant, as well as the peer review with an experienced colleague, helped ensure validity in this study.

**Reliability**

The use of mixed methods in research design for the purpose of corroborating the data also increases the reliability of the study. Reliability is the extent that the study, instrument, or methods are consistent in measuring what they are intended to measure (Ary et al., 1985). The researcher designed this study to collect information using both quantitative and qualitative methods. Data were collected through evaluation forms, questionnaires, interviews, and observations. Utilizing this design helped maintain consistency and dependability throughout the research, further supporting high reliability. According to Frechtling (2002), evaluation studies are strongest when data are collected at a minimum of two points in time. The evaluation study in this research design took initial data from 1998 through 2001 and then collected data again in 2004. Collecting data several years after the training was completed helped support reliability of the information collected.

The instruments used to collect quantitative data in this study were based upon instruments that have been used successfully in the past. The PREPS Final Evaluation Form was based on the design used by the Mississippi Writing/Thinking Institute (MWTI) across many staff development series. The MWTI has used these forms to collect data that has provided evidence for many studies (Bridges, 2001). The questionnaire was patterned after a document composed by Dr. Patricia Bridges in her
evaluation study of the PREPS English II workshop series. Both instruments have been used successfully to collect similar data in past research, adding stability to the data collection. The instruments’ stability and consistency added to the reliability and also the validity in this study.

A research technique that helped strengthen reliability was the use of an observation and interview protocol. The researcher constructed an observation and interview protocol before going into the case-study participants’ schools. Yin (1994) stresses the importance of using protocols in multiple-case design as a way to increase the reliability of the research. Another data analysis technique that helped the reliability was the construction of a matrix to analyze data in looking for patterns and themes. The construction of a matrix maintained both consistency in gathering data and structure in the analysis of the data.

**Participants**

The population for the study included the Mississippi Biology I teachers who completed the PREPS Subject Area Module between 1998 and 2001 and who are still actively teaching Biology I in the classroom. According to the PREPS databases, 159 teachers representing 72 school districts completed the series of workshops during this time period. The workshops were held in 16 locations across the state. Table 1 presents the demographic data about the participants in the Biology I professional development series.
TABLE 1. Demographic Data for Biology I Professional Development Participants

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>African-American</td>
<td>43%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>56%</td>
</tr>
<tr>
<td>Asian</td>
<td>1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>70%</td>
</tr>
<tr>
<td>Male</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Experience</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years</td>
<td>38%</td>
</tr>
<tr>
<td>5 – 10 years</td>
<td>22%</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Instrumentation**

*Quantitative Components*

The researcher collected quantitative descriptive data using two instruments. The PREPS Final Evaluation Form (see Appendix A) was the first instrument. Filled out by all participants at the end of the professional development sessions, this instrument yielded data on the initial effectiveness of the workshops. This evaluation form used a rating-scale format to gather initial reactions to the workshops. This instrument contained statements with rating scales and open-ended questions, to follow a general evaluation form successfully used by the Mississippi Writing/Thinking Institute for several years (Bridges, 2001). This form allowed the collection of data about the
facilities of the workshop, scheduling of the workshop, quality of the presentations, materials and methods used, and overall effectiveness of the workshop series. Because it included a checklist of strategies attempted in the classroom, the document also provided some idea of the implementation performed by the participants during the workshop series.

The second instrument used to collect information from participants was a questionnaire (see Appendix B) created by the researcher. Mailed out to all of the participants who completed the PREPS Biology I Module from 1999–2001, this questionnaire yielded data on the later effectiveness and use of the workshop strategies and materials. This questionnaire also used a rating-scale format to gather reactions to the workshops after several years. The researcher patterned this questionnaire after a questionnaire created by Dr. Patricia Bridges (2001) in her evaluation study of the PREPS English II workshop series. The questionnaire had a similar format to the English questionnaire, but contained Biology I content questions. Part I of this questionnaire was divided into A and B sections. Part I A asked the teacher participants to rate how the PREPS Biology I workshop affected their knowledge of specific strategies and units included in the training. The participants rated the knowledge gain for each indicator as to a great extent, some extent, and little or no extent. Part I B asked the teacher participants to rate how the PREPS Biology I workshop affected their skill in specific strategies and units included in the training. Again, the participants rated the skill gain for each indicator as to a great extent, some extent, and little or no extent. Part II of the questionnaire asked the teachers about implementation in their classrooms. In this
portion the teachers rated both materials and strategies as being regularly used, often used, infrequently used, no longer used, or never used. Part III of the questionnaire asked about the organizational structure and policies of the school. The questionnaire asked participants to rate each indicator as to strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree. Part IV asked the teacher participants whether they thought the PREPS Biology I workshop had positively impacted the students’ classroom performance and the students’ performance on the Subject Area Test. The researcher used this questionnaire to gather data for the selection of the case studies.

**Qualitative Components**

The researcher collected qualitative data using portions of the same two instruments described previously. The PREPS Final Evaluation Form included three open-ended questions and a comment area to gather additional information not included in the rating portion. The document also asked the participants to detail implementation strategies, ratings, and problems that they may have encountered.

The questionnaire contained two open-ended questions and a comment section. Part II of the questionnaire asked the teachers to choose at least one strategy used and discuss the implementation and how the implementation impacted students. This question mirrored the open-ended question on the initial evaluation form. The other open-ended question asked about teachers taking strategies and adapting them to other units of study. The comment section allowed the teachers to collaborate and further detail the use of workshop materials and strategies.
Analysis of the responses to the questionnaire yielded data that were used to select six participants for the case studies. Case-study research utilized qualitative data collection techniques such as observations and interviewing. The researcher conducted interviews with six case-study participants in each participant’s classroom and made observations of the biology laboratory area and classroom area to see whether these data correlated with the teacher-interview answers.

The researcher used interviews to collect data from the six case-study participants. The interviews were open-ended and used a protocol as a guide. Guskey (2000) supported many open-ended questions for a good interview. The general goal of the interviews was to obtain the teachers’ perspectives about the workshop materials and to document their experiences in the classrooms after the completion of the workshops. Questions were formatted specifically for each individual participant based on data collected on the returned questionnaire. In the interest of consistency of the data collected, the researcher included a group of topics and subtopics in the protocol that was asked of all participants. The interview protocol detailed (a) the background of the teacher, (b) school climate, (c) PREPS workshop learning for the teacher, (d) impact on students, (e) organization support and change, and (f) general questions about professional development. At the conclusion of each interview, all notes were typed and analyzed for common patterns and themes. Additional contacts by telephone and e-mail with each participant were made when more data were needed.

The researcher also used observations to collect data from the six case-study participants. Upon obtaining permission from the school district and the teacher, the
researcher observed each selected teacher’s classroom and lesson plans for evidence of implementation and took field notes during the observation period to describe the physical setting, documents, and other activities related to the study. The researcher developed an observational protocol to check off observations and to provide guidelines for field notes, using the protocol as a timesaver, data organizer, and as a reminder to keep baseline-data collection consistent at each site.

**Role of the Researcher**

Glesne (1999) describes the researcher role as both a researcher and a learner. Yin (1994) details the desired skills of a researcher as one who asks good questions, who listens well, who is adaptable and flexible, who has a grasp of issues being studied, and who remains free of bias. My professional experiences have prepared me for the role of a researcher (see Vita in Appendix C). In my 21-year teaching career, I taught both chemistry and biology. However, my concentration was teaching three different biological science courses for the last 15 years of my career. I participated in many professional-development initiatives in our schools through the years. From these experiences I can relate to some of the pros and all of the cons researched in the literature on effective professional-development sessions. Taking graduate classes at both Mississippi State University and the University of Southern Mississippi added to my own professional growth. In 1989 I attended my first National Science Teachers’ Convention, and this experience had a great impact on my professional career. I attended many sessions and was introduced to several new, exciting activities that could be used in my classroom. Up to that point, my teaching did not venture from the textbook and other
ancillaries that came with the text. By attending these creative sessions, I began to see
that my own classroom and teaching styles needed to change. For the next two years, I
began reading professional journals in my teaching field. Teaching biology using inquiry
and constructivist techniques was implemented in my classroom. I took traditional labs
and activities and adapted them to a more open-ended application. My colleagues and I
came a science team during this period, and we began meeting once a week after
school to discuss new activities, problems with students, and assessment techniques. We
asked our very supportive administrative staff if we could write a grant to update our
science labs and were successful in obtaining several grants for our science department.
In 1991 another biology teacher at our school and I presented our first session at the
Mississippi Science Teachers’ Convention. We presented to a packed room and received
rave reviews. This experience began a new phase in my professional career as I became
a professional development presenter.

My students loved the new teacher I had become. With the feedback from my
peers, I continued to write more innovative activities and units for use in my classroom.
After continuing to present a sample of these units at state and regional science meetings,
I was asked to become a member of the Mississippi Biology I Subject Area Teacher
Committee and the Mississippi Science Framework Revision Team. School districts
across the state were constantly asking the Mississippi Department of Education (MDE)
for presentations on these new initiatives. The MDE recommended me as a staff-
development resource, leading to my presenting professional development sessions in
more than 50 different school districts during the rest of my teaching career. Most of
these staff-development sessions were the one-shot design with durations that ranged from a couple of hours after school to a one-day session, with no follow-up sessions or long-term evaluations conducted. After a second framework revision and a new design to the Biology I Subject Area test in 1999, I worked with MDE to write the Intervention Guide for the Mississippi Biology I Subject Area Test. This document linked teaching methods and sample test questions to each assessment strand on the current Biology I Subject Area Test. In this document I detailed methods that had proven successful for my own students in my classroom. I also helped align the Mississippi Biology I Framework competencies to Mississippi Tech Prep materials and wrote five sample lessons for the training that is currently used in schools across Mississippi.

In 1998 Patricia Bridges asked me to become a developer of curricula activities of a new initiative for the Program for Research and Evaluation in Public Schools, Inc. (PREPS). From 1998 until 2001, I developed and revised the biology instructional training materials for the five-day workshop series being evaluated in this study. I was also involved as a presenter for several of the initial sessions. Yin (1994) suggested that the main way to stay on target during research is to understand the purpose of the investigation. My role as a developer and a presenter of the materials being evaluated in this study helped prepare me for this task. My role as a successful classroom teacher prepared me to ask good questions, be a good listener, and be adaptive and flexible. Glesne (1999) advocated being a researcher and a learner. My constant quest to improve my classroom by researching the latest method of teaching and adapting these methods for my students prepared me for this role. All of these experiences helped make me a lifetime learner for all aspects of educational excellence.
For the past three years, I have worked for Harcourt Assessment, Inc. as a science content assessment specialist and a test development manager for the Mississippi Subject Area Testing Program. As a science assessment specialist, I am responsible for procuring and editing test items and building new test forms for the Biology I Subject Area Test. As part of this work, I coordinate meetings with academic committees in Mississippi, work with test-item writers, and develop professional-development presentations in the areas of assessment and successful classroom instruction. As the Mississippi Test Development Manager, I work closely with the Mississippi Department of Education, the other Harcourt assessment specialists, and the Harcourt editorial team in developing ancillary testing documents, schedules for deliverables, test forms, and quality items for the Mississippi Subject Area Testing Program. This job has enhanced my role as a continuous learner and has aided in my role as a researcher to remain free of bias during the research process (Glesne, 1999, Yin, 1994). In my current job, I have participated in numerous training sessions that emphasize quality unbiased assessments. These trainings and my current job experiences have helped prepare me to be a thorough and unbiased investigator for this research study.

**Procedures**

Upon gaining approval from the Mississippi State University Office of Regulatory Compliance’s Institutional Review Board (IRB), I began the data collection process. I obtained the PREPS Final Evaluation Forms, along with the names and addresses of all
Biology I workshop participants, from the PREPS office. Analysis of the documents yielded several pertinent factors. The MWTI offered the Phase I workshops from 1998–2001; however, from 2001–2004, the PREPS office offered the Phase I workshops. During the school year of 2001–2002, PREPS implemented a new Phase II training designed as a follow-up to the Phase I workshops; nonetheless, no evidence that PREPS offered the Phase I workshops during this school year exists. PREPS offered Phase I workshops again during school years 2002-2004. The evaluation forms used in the later Phase I workshop series were very different under the direction of the PREPS office, and as a result, I decided to limit the study to the participants who completed the PREPS training during the 1998–2001 time period. This decision also aligned with research that advocates any worthwhile changes in education require time for adaptation, adjustment, and refinement (Guskey, 2000).

The initial population for the study was 159 teachers. I entered each teacher’s name, address, and school name into a database and each teacher a code number that I also put onto the questionnaire and envelope before mailing. In the spring semester of 2004, I mailed the questionnaires, along with a cover letter that explained the purpose of the study, confidentiality clauses, and expected return date. I obtained a dismal initial return rate of 31%. One teacher returned a blank questionnaire, but wrote across the top of the instrument, “I no longer teach Biology I.” This comment made me rethink the population. I only wanted to obtain data from active biology teachers, those who were still teaching in the Biology I setting. I gathered all the teachers’ schools listed in the initial population and began making inquiries. Of the original 159 teachers, 26 no longer taught at that school, 19 no longer taught Biology I, 8 had retired, and 2 had died. Only
104 teachers remained in the population. I sent out the questionnaires twice more to the remaining teachers who had not returned the instrument.

Once I had obtained the Final Evaluation Forms, I analyzed them to obtain the participants’ initial reaction to the staff-development module. I tallied and carefully documented all rating-scale categories. I collected the responses to the open-ended questions and the questions of how teachers implemented various strategies in their classrooms and put them into a database.

Responses to the questionnaire yielded descriptive statistics for each research question. Upon receipt of a questionnaire, I carefully tallied the responses and put them into an electronic spreadsheet. I calculated descriptive statistics in the form of tallies, frequencies, and percentages after I received all questionnaires. I then aggregated these results to determine answers for the original research questions. I also carefully documented the open-ended answers into an electronic format and later categorized them.

*Case Study Selection*

Part II of the questionnaire deals with implementation of the workshop materials and techniques. Part II contains 15 items on which the teachers had to rate their degree of implementation and two open-ended questions on which they detailed their classroom teaching. I used this information to select six teachers for the case studies. I took the mean for Part II from each returned questionnaire and organized the questionnaires into three categories: high-implementation teachers, medium-implementation teachers, and limited-implementation teachers. Implementation to a high extent was those teachers who averaged 4.5 or higher out of 5.0, medium implementation was those teachers who
averaged 3.8–4.49 out of 5.0, and limited implementation was those teachers who
averaged less than 3.8 on Part II of the questionnaire. Yin (1994) stressed the need to
carefully select the case-study participants so that they will either predict similar results
or produce contrasting results for predictable reasons. I carefully analyzed each teacher’s
questionnaire, taking into consideration the responses to the open-ended questions. I
decided to select two teachers at each implementation level from different school
locations and various school accreditation levels. By selecting two cases
in each of the three implementation level categories, I hoped that similar patterns and
themes would emerge within and between each category.

I contacted the case study participants by telephone to see whether they would
continue to take part in the study. Upon teacher agreement, I also obtained permission
from the individual school districts to visit each teacher’s school to collect data from the
teacher through personal interviews and lesson plans, as well as to acquire Biology I
Subject Area Test score data from the school. The visit with each teacher took place in
the fall semester of 2004. I conducted informal interviews and observations within each
visit either during the teacher’s planning period or after school.

**Data Analysis**

The initial PREPS Evaluation Form, the questionnaire, and transcripts from the
case-study interviews yielded data for this research study. I collected 159 PREPS
Evaluation Forms from the PREPS offices and mailed the questionnaire to all 159
participants at the beginning of the data collection. However, after investigating and
discovering that only 104 teachers were still teaching in the Biology I classroom, these
104 teachers became the population for the study. After two additional mailings, I obtained in early fall 2004 a final return rate of 68% (71 out of 104). For the remainder of this section, I will present each research question along with a description of the methods and procedures used to analyze the descriptive data for each question. Lastly, I will detail the analysis process from the interviews of the case-study participants. The interview and observation data from each case study helped to answer all of the research questions.

Research question one asked the following: How did the participants rate the effectiveness of the PREPS Biology I workshop? My analysis of the PREPS Final Evaluation Forms and the case-study interviews answered this question. The PREPS Final Evaluation Forms provide initial reactions to the location of the workshops, the presenter, and the materials and strategies presented. These documents also allow the participants to describe initial implementation techniques within the time frame between the workshop sessions. For the closed questions, I tallied and calculated the frequencies and percentages for each response. I also documented, tallied, and determined the percentages for the checklist portion. I then categorized and coded the responses for the open-response items for similarities in the responses.

Research question two asked the following: To what extent did the participants acquire the intended knowledge and skills presented in the PREPS Biology I workshop? Responses to the PREPS Final Evaluation Form, the questionnaire, and responses to interviews yielded data to answer this question. Statements written on the PREPS Final Evaluation Forms addressed each teacher’s knowledge and skill gain. I categorized,
coded, and documented these statements. Most of the data came from Part I of the questionnaire from all participants who returned this instrument. I took the mean from the fourteen indicators in Part I A that described to what extent the workshop improved the participants’ knowledge. I also took the mean from the fourteen indicators in Part I B that described to what extent the workshop improved the participants’ skills. For all indicators, I tallied and calculated the frequencies and percentages for each response. Any written responses on the questionnaire that pertained to gain in knowledge and skills were documented and categorized for similarities in the responses. Interviews and observations with the six case-study participants yielded more in depth information about this research question.

Research question three asked the following: What organization characteristics and structures were in place to support teacher change in the schools of the participants in the PREPS Biology I workshops? I collected data from Part III of the questionnaire from all participants who returned this instrument. I calculated the mean from the twelve indicators that described the school support system. For all indicators, I tallied and calculated the frequencies and percentages for each response. Any written responses on the questionnaire that pertain to gain in knowledge and skills were documented and categorized for similarities in the responses. Interviews and observations with the six case-study participants yielded more in depth information about this research question.

Research question four asked the following: To what extent did the participants in the Biology I workshop use the units and strategies in their classrooms? I answered this question by looking at responses to three instruments: the PREPS Final Evaluation Form,
the questionnaire, and the responses to the interviews. The PREPS Final Evaluation Forms allows the participants to check the strategies and activities they had implemented from the first four sessions. These forms also asked the participants to describe initial implementation techniques within the time frame between the workshop sessions. For the closed questions, I tallied and calculated the frequencies and percentages for each response. I also documented, tallied, and determined the percentages for the checklist portion, then categorized and coded the responses for the open-response items for similarities in the responses. Other data came from Part II of the questionnaire from all participants who returned this instrument. I took the mean from the fifteen indicators that described to what extent the teachers implemented the practices. I also documented, tallied, and determined the percentages for each practice. This document also included two open-ended questions to further describe implementation. I categorized, coded, and documented responses for these open-response items for similarities in the responses.

The classroom observations, any lesson plan documentations, and interviews with the six case-study participants also provided additional information for this research question.

Research question five asked the following: Did the teaching strategies and classroom units affect student performance or achievement? Statements written on the PREPS Final Evaluation Forms addressed the students’ performance. I categorized, coded, and documented these statements. Part IV of the questionnaire provided data from all participants who returned this instrument. Interviews with the six case-study participants provided more detail of student performance in the classroom. By
obtaining classroom test scores from the case studies and the Biology I Subject Area Test scores from the schools of the case-study participants, I collected student achievement data. Because the PREPS workshop series did not provide classroom activities and evaluation methods for all areas of the Biology I Subject Area Test, any increase or stabilization of scores could not be credited solely to the workshop. However, the PREPS Biology I workshop addressed one entire assessment strand, Nature of Science, with the experimental design and graphing unit (Bridges, 2000). Harcourt Assessment, Inc. has provided each school a School Summary Report by Assessment Strand (Malone, 2001). This report detailed the raw scores for each assessment strand on the Biology I Test and compared the school average score with the district and the state averages. I used these score reports from the case studies’ schools to detail trends in student achievement for one area of the Biology I Subject Area Test.

I began the interviews and observations of the case studies in late fall 2004. Upon receiving each case study participant’s agreement to participate in the study, I interviewed each teacher in his or her classroom. The interviews and observations were informal, using protocols to ensure that time was well utilized and that consistency was maintained between interviewees. I decided to take notes rather than tape record the interviews when the first teacher seemed uneasy with the small recorder. However, as I left each school, I quickly pulled out a portable tape recorder and recorded initial thoughts and then read through my notes before I could forget anything. This process helped clarify my notes when I begin transcribing the interview and observation field notes.
Yin (1994) stated “Data analysis consists of examining, categorizing, tabulating, or otherwise recombining the evidence to address the initial propositions of a study” (p.102). I typed the interview and observation notes into an electronic database. Initially I typed all notes, even if they did not directly answer a research question. I then printed out, scrutinized, and highlighted by different colors these extensive notes by research question. I finally structured all data into more detailed subcategories. Glesne (1999) asserted that as the data are analyzed, the categories will divide and subdivide. I noted patterns and themes in a matrix to combine all the interview and observation data with the appropriate research question. I added the quantitative data to the increasing matrix. I printed out graphics for all quantitative data to help analyze trends in the survey answers. I analyzed data to see whether the various tallies, responses, and observations were supportive or contradictory in each category. I marked data and made written notations on the matrix, continuing the refinement process. Researchers use many techniques, such as coding and data displays, to help find themes in data, but researchers must find ways to make connections that will be meaningful to them and the reader (Glesne, 1999). My initial plan was to use the PREPS Final Evaluation Form only for research question one, the initial workshop reactions. However, the comments tabulated from the instruments, along with the vast implementation documentation, made these data valuable for more than one research question. I carefully scrutinized all data to ensure that I had recognized major themes. When I completed and organized the tabulations and matrices, I sent them to a peer reviewer for comments and suggestions. The peer reviewer pointed out several connections between the data that was very
helpful. After I compiled the initial results for each research question, I also sent initial results to the peer reviewer for verification. I collected information from the peer reviewer and finalized answers to each research question. I then cross referenced the key points from the literature review with the results and tabulated the connections. By combining all data, results, and literature findings conclusions were finalized for the study. I submitted the final conclusions to the peer reviewer for a last verification and completed this phase of the study.
CHAPTER IV
THE STUDY

This study investigated the impact of the PREPS Biology I Subject Area workshop series on teachers and the teachers’ classrooms. This chapter describes the research study and the results of the research study. The first section briefly describes the sources of data that were used to collect the quantitative and qualitative data in the study. The second section describes the six case study participants that were involved in the study. The third section describes the results of the study and lists each research question with specific details of the results. The fourth section provides an overall summary of the results.

Sources of Data

The purpose of this study was to evaluate the PREPS Biology I Subject Area workshops using Guskey’s evaluation model as a guide for the process. There were three sources of data for this research study: The PREPS Final Evaluation Form (Appendix A), a questionnaire (Appendix B), and the six case study participants in their respective schools.

The initial reactions to the workshop were documented in the PREPS Final Evaluation Form. Filled out by all participants on the last day of the PREPS Biology I
workshop, this instrument yielded data on the initial effectiveness of the workshops. This evaluation form used a rating-scale format with open-ended questions to gather initial reactions to the workshops. This form allowed the collection of data about the facilities of the workshop, scheduling of the workshop, quality of the presentations, materials and methods used, and overall effectiveness of the workshop series. Because it included a checklist of strategies attempted in the classroom, the document also provided some idea of the implementation performed by the participants during the workshop series.

The second source of data was a questionnaire mailed to all participants who attended the PREPS Biology I workshop series between 1998 and 2001. This questionnaire also used a rating-scale format along with open-ended questions to gather reactions to the workshop after several years had passed. The participants were asked to rate how the PREPS Biology I workshop had affected their knowledge and skills for the specific strategies and units included in the training. It also asked the teachers about the organizational structures and policies of their school. The questionnaire asked the participants about implementation of the strategies and materials in their classroom. The final part of the questionnaire asked the participants whether they thought the PREPS Biology I workshop had positively impacted the students’ classroom performance and the students’ performance on the Biology I Subject Area Test.

The third source of data was the six case-study participants. I conducted interviews with six case-study participants in each participant’s classroom and made observations of the biology laboratory area and classroom area to see whether these data correlated with the teacher-interview answers. The general goal of the interviews was to
obtain the teachers’ perspectives about the workshop materials and to document their experiences in the classrooms after the completion of the workshops. I asked the teachers to provide classroom test scores for the topics that were included in the PREPS Biology I workshop. The case study’s schools provided data on the Biology I Subject Area Test for each assessment strand for the past two years.

The Case Studies

After analyzing all questionnaires, I divided them into three levels of implementation – high, medium, and limited. Further analysis of the teacher responses to the open-ended questions on the questionnaire yielded further information. I carefully analyzed each teacher’s questionnaire, taking into consideration the responses to the open-ended questions. I decided to select two teachers at each implementation level from different school locations and various school accreditation levels.

The six teachers who agreed to become a part of this study are representative, to some extent, of the diversity of the teachers who participated in the PREPS Biology I workshop (see Table 1). Four teachers are Caucasian and two teachers are African-American. There are five female teachers and one male. Two teachers have been teaching for more than 10 years and four teachers have been teaching between 5 and 10 years. The case study participants teach in high schools with student populations ranging from 320 students to 1,300 students. The socioeconomic make-up of the school districts ranges from 28% of students eligible for free or reduced lunch to 98% of the students eligible for free or reduced lunch. Four of the teachers’ schools have a current accreditation level of 3 (Successful), one teacher’s school has a level of 4 (Exemplary)
and one teacher’s school has a level of 5 (Superior-Performing). These accreditation levels are based on the Mississippi School Accountability model, in which each school’s performance classification is based on data gathered from student testing (MDE, 2003a). The remainder of this section describes each teacher in more detail. The teachers’ names have been changed for reporting in this study.

**Olivia**

Olivia is a veteran teacher of 24 years who has a BS degree in Home Economics and a MS in Special Education. She is currently in her eighth year of teaching biology. Because of the number of science hours she obtained in her undergraduate degree, her administrators asked her to teach one class of Biology I during the 1997-98 school year. She enjoyed teaching the class so much that when approached about teaching more classes the next year she eagerly agreed. During the 1998–99 school year, Olivia also attended the PREPS training, the first year it was offered. Olivia currently teaches two sections of botany/environmental science and four sections of Biology I. One other teacher teaches a section of biology. Olivia’s school follows a seven-period-day schedule.

Olivia teaches in a county school district in northern Mississippi. Olivia grew up in the small community where she currently teaches. Her school is the largest of the high schools in the district with a student population of approximately 660 students. The district enrollment for the 2002–2003 school year was about 94% White, 5% African American, and 1% Asian, Native American and Hispanic (Mississippi Department of Education [MDE], 2003d). Approximately one-third of the students are eligible for
free or reduced lunch and the percentage of the district served by the Title I Program is just over 15%. Olivia’s district has a graduation rate of 87%. The school has a current accreditation rating of 3 on a 5-point rating scale.

Olivia is currently a candidate for National Board Certification for the 2004–2005 school year. She loves teaching and was very enthusiastic about describing her teaching experiences. Olivia described her classroom as active. She tries to incorporate hands-on activities at least once a week. She estimates that her students have some sort of laboratory experience at least once every two weeks. Olivia and the Computer Discovery teacher wrote a successful $40,000 grant to build environmental trails and a learning center gazebo on the school campus. The outdoor study area encompasses approximately one acre of land and was completed during the 2003–2004 school year. This year she and her students are planting Mississippi-native trees, grasses, and wildflowers in the area. Her students currently study wildlife, insects, trees, and other plants that are native to the area from the nature trail. Olivia and her students continually write observations and keep logs of the site for comparison studies in future years. Olivia is extremely proud of the area and the impact it has had on her students.

Olivia’s classroom is located in a tiny building set apart from the main office building. In fact, one has to walk through two other annex buildings after leaving the central office to get to Olivia’s classroom. Obviously the school has built several additions. Olivia’s classroom is large, with a teacher’s desk in the front right corner of the room. A Smart Cart, containing a television, VCR, computer, and printer, is next to the teacher’s desk. There are 30 desks arranged in neat rows to accommodate Olivia’s
largest biology class of 30 students. Two large stand-alone sinks with four tables surrounded each sink take up the rear of the room. Each table can seat four to five students, making the laboratory area capable of holding up to 32 students comfortably. The laboratory area has several ongoing projects and several notebooks with brightly colored lettering stacked in several piles. Olivia explained that these were projects on which her environmental science classes were currently working. Some of the notebooks were log books from the outdoor classroom. Two bookcases in the room are filled with many reference books, notebooks, and stacks of plastic containers.

From one of these bookcases, Olivia pulled out her worn but intact PREPS Phase I Biology binder. She also showed me her plastic mitosis container that was filled with duplicated materials of the labs we had performed in the workshops. In fact, she had just finished teaching the mitosis lessons. She explained exactly how the students used the materials. What she had done was exactly as the workshop directions had specified. Olivia expressed that she did not know what she would have done without the PREPS training. It gave her knowledge that she desperately needed to begin her biological science-teaching career. Olivia also has shared all the PREPS materials with the other biology teacher. On the questionnaire, Olivia reported an average of 4.5 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. While she admitted that she did not use everything each year, she had used the materials faithfully and said that they work for her students. She said the workshop gave her science-framework knowledge, along with the pedagogical knowledge she needed for the Biology I Subject Area Test.
Current professional development for Olivia’s school consists of the early Wednesday afternoon dismissal. She says they usually have a faculty meeting and return to the classrooms to work. Olivia said that she and the other biology teacher get together during this time and share materials. She also utilizes the time to work with a colleague who is also going through the National Board certification process. She said the school may have a speaker once or twice a year to address a general topic. Occasionally, the school will have a full day professional development for the entire district. Usually during this time, a speaker is present. Olivia said that there is no central theme for the professional development and the sessions that they have is on various topics. Olivia shared that she can attend workshops outside the school, but would have to take a personal day due to budget cuts.

Karen

Karen is currently in her eighth year of teaching biology. She has been teaching in her current position for three years. Karen has a BS and an MS degree in Secondary Education with an emphasis in biology. She currently teaches five sections of Biology I and one section of Science Skills and Reasoning. Karen is one of three teachers currently teaching Biology I. Her school is on an alternating A/B Block schedule with 95-minute classes. Karen currently has approximately 25 students enrolled in each of her classes.

Karen teaches in a large county school district in central Mississippi. Her school is the largest of seven high schools in the district with a student population of approximately 1300 students. The district enrollment for the 2002–2003 school year was about 75% White, 20% African American, and about 5% Asian, Native American and
Hispanic (Mississippi Department of Education [MDE], 2003d). Approximately 28% of the students are eligible for free or reduced lunch, and the percentage of the district served by the Title I Program is approximately 21%. Karen’s district has a graduation rate of about 93%. The school has a current accreditation rating of 5 on a 5-point rating scale.

Karen has taught in three schools, two in this district. She said when she obtained a job in this school, she felt that she had “died and gone to heaven.” She enjoys teaching enormously and spends many hours outside her classroom working with the drill team, sponsoring the Junior Academy of Science program, and sponsoring various other student activities in her school. Karen describes herself as totally dedicated to making an impact on her students and preparing them for the future to the best of her ability. Karen attended the Howard Hughes Medical Institute Summer Teacher Scholar Program in 1998. At a former school, she sponsored the state winner of the 1998 NASA Space Science Student Involvement Program.

Karen’s school was very large. Her classroom was in a different wing from the main office, but in the same building. Karen’s room was a combination of lecture area and laboratory area. It almost looked as if the room had been two rooms at one point. In the lecture area a large blacktopped demo table served as the spot for Karen’s book and notes when she was explaining concepts. Approximately 30 desks were lined in rows facing this demo table. The lab area was composed of two large stand-alone sinks with four tables projecting from different angles. Each table seated four students, so the
lab area had a capacity of 32 students. Karen had several charts, posters, examples of student work, and a large bulletin board of student pictures.

The bulletin board caught my eye. Karen explained that she loved to capture on film her students performing different lab experiments. She said she also photographs projects to inspire her next year’s classes. I had to ask about one photograph of Karen and a student holding a large homemade doll. Karen said her students had to make presentations of genetic disorders, and this student had made a large doll to explain the physical defects for her assigned disorder.

Karen’s laboratory area had the appearance of being used and being used often. Materials were stacked on several of the tables. She explained before the interview that she was trying to “straighten up” before I arrived.

In our interview, Karen told me she went through the PREPS professional development workshop during the 1999–2000 school year. After she completed the workshop, she was asked to present two of the PREPS sessions the next year. Karen loves the PREPS materials. She shared many adaptations of the materials, especially the idea of student-designed experiments. She is a major advocate of school science fairs and was so glad to see the scientific method emphasis in the PREPS workshops. Karen reported on the questionnaire an average of 4.86 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. Karen wrote on her questionnaire, “I feel that the opportunities and activities provided by the PREPS workshops have been an asset to me and my students. These are activities that target every child.”
Karen’s school has an elaborate professional development program. The on-going theme this year is entitled “A Handbook for Classroom Instruction that Works.” Staff from the MWTI comes to the school eight days throughout of the year to work with the teachers during the teachers’ planning periods. The format is very similar to the PREPS Biology professional development series. The teachers have assigned strategies that are appropriate for their classroom situation to try with the students. They report back in the next session as to the successes or non-successes of the activities. The focus of these activities is using reading and writing in the classroom. Karen’s school district offers an intensive professional development program during July and August for all teachers in the district. The teachers can attend as many sessions as they like and obtain CEU credits for attending and completing the sessions. Karen says that they stay after school at least once every two weeks for general meetings, either by department or by entire faculty. The school has no early dismissal for these faculty meetings.

Gloria

Gloria is a teacher with 10 years of experience who has a BS degree in Biology and an MS in Secondary Education with an emphasis in biology. She is currently in her ninth year of teaching biology at her present school. Gloria currently teaches three sections of Biology I. She taught three sections of Science Skills and Reasoning last semester. She is one of two Biology I teachers. Gloria’s school is on a 4-by-4-block schedule.

Gloria teaches in an urban school district in the Mississippi Delta. Her school is the one of two high schools in the district and has a student population of approximately
600 students. The district enrollment for the 2002–2003 school year was approximately 5% White and 5% African American (Mississippi Department of Education [MDE], 2003d). Approximately 85% of the students are eligible for free or reduced lunch, and the percentage of the district served by the Title I Program is approximately 100%. Gloria’s district has a graduation rate of almost 75%. The school has a current accreditation rating of 3 on a 5-point rating scale.

Gloria enjoys teaching and working with students in any situation. She was very excited and animated when describing her teaching experiences. Gloria tries to incorporate hands-on activities at least three times a week. Gloria’s classroom was located in the same building as the central office but down a couple of very wide hallways. Gloria’s classroom was very large with two teacher’s desks in the room, one in the front and one in the back next to the laboratory area. The first thing I noticed upon entering the room was a huge, colorful mural representing all the biomes painted on the wall along the entire laboratory area. Gloria explained that a former biology teacher painted the mural. Gloria said she uses the mural to ask the students questions about the biomes and to write down possible food chains from the organisms pictured. A Smart Cart, containing a television, VCR, computer, and printer, is next to the teacher’s desk in the front of the room. Thirty-two desks are arranged in neat rows to accommodate Gloria’s largest biology class of 30 students. Two large stand-alone sinks with four tables surrounding each sink take up the rear of the room. Each table can seat four to five students, making the laboratory area capable of holding up to thirty-two students comfortably. The laboratory area was filled with a multitude of equipment. Gloria’s
desk next to the lab area clearly had the PREPS handouts, easily recognized from the training, stacked ready to distribute to her students. I jokingly told Gloria that she did not have to use the PREPS materials just because I was visiting. She said she uses all the PREPS materials in the experimental design unit, and that was what she was teaching to her Biology I classes that day. The laboratory equipment was set out to go with the handouts on equipment names and uses from the PREPS material.

Gloria had three bookcases in her classroom and laboratory area filled with many reference books, notebooks. She had two closet areas just off each end of the room that were filled with supplies of all types. From one of these bookcases, Gloria pulled out three notebooks containing her teaching materials. She had PREPS materials all throughout the notebooks. She also adapted the PREPS materials for her Science Skills and Reasoning classes. Gloria displayed her lesson plan books to show how she skillfully incorporated the materials into each class.

Gloria attended her first PREPS workshop during the 1999–2000 school year. She learned about the workshop from a brochure posted in the school. Her district sent Gloria to attend the workshop again the following school year. Gloria admitted she did not mind going through the workshop twice but said that she could have used those days to attend another professional development session. On the questionnaire, Gloria reported an average of 4.2 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. While she admitted that she did not use everything each year, she had used some of the materials faithfully and said that they work for her students. She shared with me that she was sold on the experimental design
and graphing materials the first time she used them with her students. Not only did the students understand and perform much better during the course, they came back to Gloria and asked for samples of the PREPS handouts when they began preparing for the ACT test a couple of years later. Gloria was amazed that they remembered the materials. This incident gave Gloria strong evidence that not only does this material work, but it also makes an impact on students.

Current professional development for Gloria’s school consists of the early Wednesday afternoon dismissal. She said occasionally the teachers will work together as a science department, but they usually focus on the school reform initiative called “First Things First.” Gloria said that four times a year both schools meet together for an all-day professional development day for the district. Usually during this time, a speaker is present. Gloria said her ideal professional development session is a series of sessions related to science, like the PREPS sessions. She said she really enjoyed having assignments to take back to try in her classroom. She also enjoyed sharing with colleagues from across the region the successes and failures of the attempts and working together to plan the ideal teaching strategies.

Anita

Anita is currently in her tenth year of teaching biology. She has been teaching in her current high school for seven years. Anita has a BS degree in Secondary Education with an emphasis in biology. She currently teaches three sections of Biology I and three sections of botany/environmental science. She is one of two teachers currently teaching Biology I. Her school has just returned to the seven-period-day schedule after being
on the 4-by-4-block schedule for the past five years. Anita currently has approximately 20 students enrolled in each of her classes.

Anita teaches in a county school district in north Mississippi. Her school is the second largest of three high schools in the district with a student population of approximately 600 students. The district enrollment for the 2002–2003 school year was just over 90% White, about 8% African American, and about 2% Asian, and Hispanic (Mississippi Department of Education [MDE], 2003d). Approximately 48% of the students are eligible for free or reduced lunch and the percentage of the district served by the Title I Program is approximately 67%. Anita’s district has a graduation rate of 78%. The school has a current accreditation rating of 3 on a 5-point rating scale.

Anita loves teaching and especially loves teaching biology. Her classroom was located down a long hall connected to a large open atrium/cafeteria area. The building appeared new and was very clean and bright. Anita’s love of teaching was apparent from her classroom and lab areas. Her room was the typical modern classroom with a large laboratory/demo table that also serves as the teacher desk in the front of the room. Twenty-two desks were lined in rows between the massive teacher’s lab table and the back wall. Two porcelain dry-erase boards were full of terminology and assignments for the classes. I visited Anita before the Christmas break, and the students had been studying DNA the previous week. Anita had a huge artificial Christmas tree in one corner of the room full of colorful, student-made DNA ornaments. The craftsmanship was wonderful, and the detailed labeling of the parts indicated that the students put a great deal of time into this project. The laboratory area was next door in a separate room
from Anita’s classroom. It was evident that this laboratory area was being used for biological studies. Microscopes were out with slide boxes, cover slips, and pipettes on the supply table. The sinks were wet, and the trashcans were full of lens paper and discarded color drawings. It was very evident that this lab had been used very recently and that the students had used the microscopes. Anita explained that her classes had been observing a pond water sample for protists and other organisms.

In our interview, Anita told me she went through the PREPS professional development workshop during the 1999–2000 school year. She learned about the workshop because it was posted on a flyer next to the office. She asked if she could attend the training and was granted permission. She said she loved everything about the training. She said she never thought about teaching the units in the way they were presented. Anita said that when she attended classes in college, she learned theories of how students learn. The problem was that she did not know what actually worked with the students. She said the PREPS training showed her how to pace her lessons and lead the students into making inferences and drawing conclusions about the topics. She said the experience was wonderful for her. Anita reported on the questionnaire an average of 4.0 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. Anita admitted that she did not implement all of the PREPS materials into her classroom; however, the materials she uses are incorporated with enthusiasm. She said she did not work through the mitosis and meiosis role-play activities in her training session; therefore, she did not use these in her classroom. Anita uses all of the experimental design and graphing materials in her classroom today. She showed me the
lesson plans where the activities were listed. Anita was so impressed with the PREPS training that she came back from the workshop and shared many activities throughout her district. She showed me a notebook of activities that were shared last year for other teachers in the district. This notebook contained many of the PREPS materials.

The current professional development in Anita’s school consists of teacher workdays. She says that the school has six designated days in which the students do not come to school, but teachers have a meeting for half of the day and have a speaker or other presentation for the other half of the day. The professional development initiatives focus on no central theme. However, Anita said that the science teachers have gotten together to share successful strategies, and this is when she demonstrated some of the PREPS materials described previously.

*Robert*

Robert is currently in his eighth year of teaching science. He has been teaching in his current high school for five years. Robert has a BS degree in Secondary Education with an emphasis in biology. He currently teaches three sections of Science Skills and Reasoning and one section of Biology I. Robert shared that he taught five sections of Biology I last year. He is one of three teachers currently teaching Biology I. Robert’s school is on the seven-period-day schedule, and he currently has approximately 23 students enrolled in each of his classes. Robert is also a coach and has had a very successful team for the past three seasons.
Robert teaches in a county school district in the east central portion of Mississippi. His school is the only one in the district and has a student population of approximately 800 students in the high school. The district enrollment for the 2002–2003 school year was about 70% White, 20% African American and approximately 10% Asian, Native American, and Hispanic (Mississippi Department of Education [MDE], 2003d). Approximately 43% of the students are eligible for free or reduced lunch, and the percentage of the district served by the Title I Program is approximately 75%. Robert’s district has a graduation rate of approximately 78%. The school has a current accreditation rating of 4 on a 5-point rating scale.

Robert shared with me that he loves working with students. He said the reason he is in the school is because of the children. Robert’s classroom was in a separate building from the central office and was connected by a covered walkway. The building appeared old but was in good shape. Robert’s classroom contained a tremendous number of storage cabinets and shelving along the perimeter of the room. These cabinets contained two sinks. The teacher’s desk was in the center of one wall with the green chalkboard behind it. A short, elongated bookcase with two shelves was behind the teacher’s desk under this chalkboard and was filled with notebooks and other textbooks. The teacher’s desk was covered with papers that were haphazardly stacked. A teacher’s edition of two biology books was also on the desk with a grade book and lesson plan book. A television and VCR sat in the corner of the room on a tall black cart. My first impression of Robert’s classroom was “empty.” Nothing was on the cabinets, and nothing was stored on the elaborate shelving unit above the cabinets. The only paper visible on the walls was
on the bulletin board, which contained a large bell schedule. Robert shared with me that this was his second year in this classroom. He said that he had access to the biology lab, which was around the corner in the building with the central office. Robert said his students perform some type of hands-on activity at least once a week.

Robert expressed concern about the Biology I Subject Area testing situation. He indicated that he and his students are stress by the test. He really wants to get away from teaching Biology I because of the stress of the test. He thinks the addition of a pre-biology class to his school’s course offerings will help the lower-level students perform better on the state test. He said it is hard to take students that perform at a lower level than average and get them ready during the one-year biology course. Another way the school has tried to help the lower performing students is by the introduction of a program called Biology Workshops on Wednesday (WOW). Any student can stay after school on Wednesday afternoon to get extra help in biological topics. Robert directed me to a large chalk outline on the sidewalk outside his window. I recognized this as a faint drawing of a cell. He explained that last Wednesday the topic was organelles of the cells. For this activity, the students had to go stand on each part of the cell and tell the function of that part. He says that the other biology teachers alternate staying with the students on Wednesdays and perform fun activities with the students. Robert said his coaching duties interfere with his help in the program, but he supports the effort. He added that the students who really needed the extra help often do not stay.

In our interview, Robert told me he went through the PREPS professional development workshop during the 1999–2000 school year. He found out about the
workshop through his principal and was told to attend. Robert said he enjoyed the training, and that he had implemented many of the activities and worksheets from the training into his classroom. I asked him to pick one activity and describe how the students performed. The activity he described was not part of the PREPS training. I began specifically asking about the PREPS strategies after this occurred. Robert reported on the questionnaire an average of 3.3 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. He said he had used the paper towel experiments with the graphing but not this year. He also said he did not use any of the role-play activities because he was just not a role-player type of teacher. He loved the graphing worksheets, experimental design worksheets, and the mitosis worksheets. Robert did share his PREPS notebook of activities and strategies with a new teacher who just came into the school. I saw his PREPS notebook in the bookcase behind his desk and asked if I could look through it. The materials were complete and looked brand new.

The current professional development for Robert’s school consists of the early Wednesday afternoon dismissal. He said they usually have a faculty meeting or a departmental meeting, and return to the classrooms to work. Robert stays for this occasionally but is usually with his players on the field. He said they meet with the Vo-Tech teachers to integrate Tech Prep activities. He stays for these sessions. The school also has three days at the beginning of the school year and two days during the year for professional development. He says the school sometimes has a speaker and a planned activity but not always. Robert said that his school has cut back on sending teachers to workshops outside the school due to cuts in the money from the state.
Valerie is a veteran teacher of 22 years who has a BS degree in Secondary Education and a MS in Special Education. She currently teaches one section of botany, one section of science skills and reasoning, two sections of physical science, and two sections of biology. She is the only teacher currently teaching Biology I. Valerie’s school follows a seven-period-day schedule.

Valerie teaches in a county school district in the northwestern portion of the Mississippi Delta. Valerie grew up in the small community where she currently teaches. Her school is the only high school in the district and has a student population of approximately 320 students. The district enrollment for the 2002–2003 school year was approximately 99% African American, and about 1% White and Hispanic (Mississippi Department of Education [MDE], 2003d). Approximately 98% of the students are eligible for free or reduced lunch, and the percentage of the district served by the Title I Program is 100%. Valerie’s district has a graduation rate of about 83%. The school has a current accreditation rating of 3 on a 5-point rating scale.

Although Valerie’s school was very old, her classroom was located in a new annex building set apart from the main office building. In fact, one has to walk through three other annex buildings after leaving the central office to get to Valerie’s classroom. Her room was the typical modern classroom with a large laboratory/demo table that also serves as the teacher desk in the front of the room. Valerie’s classroom contained no desks and instead featured a series of tables and chairs that accommodated her largest class of twenty-three students. In the center of the room were two large stand-alone sinks spaced out evenly lengthwise along the room. Two walls were lined with cabinets that
also contained sinks. These sinks had pegboards above them that contained graduated cylinders, beakers, and other glassware that appeared freshly washed. Along the wall of windows to the left of the teacher’s desk were six computers. Valerie explained that the students could use these computers to look up things and work on papers. She said she wished she were more technologically literate but that she did not even know how to check e-mail. The laboratory area had several trays of plants around the room and what appeared to be “grow lights” in several locations. Valerie explained that these were projects on which her botany classes were currently working.

During the 1998–99 school year, Valerie attended the PREPS training, the first year it was offered. She loved the experimental design unit and explained how she used the sponge animal experiment with her classes. She also has used the paper towel experiments for graphing but does not use the activities every year. Valerie said that she has recently revisited the reading strategy from the workshop because reading is the biggest problem in her school. She said the students had a very hard time reading the sample experimental designs to pick out the variables. She said she has to go slow with her students. Valerie explained that she mixes the mini-laboratories that come with her textbook with the PREPS materials. On the questionnaire, Valerie reported an average of 3.46 on a 5-point scale for implementation of the strategies modeled in the PREPS Biology I workshops. She admitted that she uses the review guide from the PREPS workshop and does build cell mitosis models but does not use the role-play activities.

Current professional development for Valerie’s school consists of the early Wednesday afternoon dismissal. She said the school usually has a faculty meeting and
focuses on different topics. Valerie said that the focus for the professional development had no central theme. Sometimes the teachers focus on discipline, sometimes writing across the curriculum, and sometimes classroom management. Valerie said that this professional development approach did meet needs, but it would be nice to focus on content rather than general topics. Valerie shared that her school has a science department faculty meeting every Monday after school.

Results

The results of this study involved careful analysis of the data gathered from all three data sources described above. The rest of this section will provide results for each of the five research questions. For each research question, the indicators from the PREPS Final Evaluation Forms and the questionnaires are used to outline the data results. Information gathered from the interviews and observations with the case studies, which add depth to each research question, is also presented. Finally, for each question all results will be summarized and general conclusions outlined based on the analysis of the data.

Research question one: How did the participants rate the effectiveness of the PREPS Biology I workshop?

This research question related to Guskey’s (2000) first level of evaluation. At this level the focus is whether the participants liked the experience, whether they felt their time was well spent, whether the materials made sense to them, whether the materials were useful, or whether the instructor was knowledgeable and helpful (Guskey, 2002a).
Guskey advocated that measuring the initial participant reaction not only helps with the design and delivery of future programs, but it also serves as a valid prerequisite to higher-level evaluation results.

Through analysis of the PREPS Final Evaluation Form and case-study interviews, I answered this question. I collected data for research question one primarily from the PREPS Biology I Final Evaluation Form (see Appendix A). Participants completed this evaluation form on the last day of the PREPS Biology I Workshop series. I located and identified 159 evaluation forms from 18 different sites for the time period in the study. This number correlated to the registration material for this period.

I collected quantitative data from the eight rating-scale items on page one of the form. These indicators provided information on the participants’ initial reactions to the facilities, scheduling, quality of content, quality of delivery, presenter, small group work, units/handouts, and overall effectiveness. Summarizing the checklists that asked the participants which strategies they had tried in their classroom during the workshop series also provided quantitative data. The quantitative data appear in Appendix D, Table 9 and Table 10. I collected the qualitative data from the comments sections and the four open-response questions included on the evaluation form, as well as from the interviews with the six case-study participants.

The first questions tallied on the PREPS Final Evaluation Form related to the logistics of the workshops. The form asked participants to rate their evaluation of the logistics on a Likert-type scale with a rating of 1 being the lowest and a rating of 5 being the highest. The form asked participants to rate the facilities used for the workshop
locations and the scheduling of workshops. The overall mean was very high for both categories. The participants rated the facilities 4.72 on a 5-point scale. The overall scheduling mean was 4.67 on a 5-point scale.

Additional comments written on the forms provided evidence that a possible scheduling change occurred during the presentation of some of the workshops. One session containing nine teachers wrote on their forms N/A beside scheduling and one teacher wrote “different schedule.” Upon further investigation into that session, I discovered that this session occurred in a two-day/two-day format. In another session containing twenty-four teachers made such comments as “This was not our schedule, but I wish it was like this.” Other such comments were the following: “Have the workshop earlier in the year, maybe August to September” and “I needed these materials earlier when school started.” This session was held for four consecutive days during the middle of the school year.

Because of the literature supporting on-going professional development and the fact that the PREPS original design was for the workshop series to be held throughout the year, I included interview questions with the six case studies dealing with the scheduling and design of the workshop. Valerie said that the scheduling was a major strength of the series. She said having an opportunity to come back into her classroom and work through activities with her students really helped. She said this schedule also prevented her from coming back from the workshop sessions and putting the notebook of activities on a shelf and not using it. Anita told a story similar to Valerie. Anita loved the model in which you have to go back into the classroom, use materials, and return to the workshop
and share with the others about the experiences. Karen and Robert both agreed that the design of having the workshop broken up throughout the year was great. Karen added that the schedule gave her something to look forward to because the materials at each session were wonderful.

The PREPS Final Evaluation form also asked participants to rate the quality of the presentations in terms of content and delivery, using a Likert-type scale with a rating of 1 being the lowest and a rating of 5 being the highest. The overall mean for the quality of the content was 4.84 on a 5-point scale. A few comments describing the content were “The graphing skills and experimental design materials were desperately needed. They are excellent”; “This was the best workshop I have ever attended. It gave me more useful material than any other”; and “I was able to go beyond the textbook with the mitosis and meiosis unit and my students absolutely loved it.”

In the delivery of the workshop series, the overall mean was 4.82 on a 5-point scale. Most of the comments relating to delivery dealt with both the organization and the methods used in the delivery of the materials. One of the comments was “The activities and organization of the units were very effective.” Another comment was “The information was very well arranged.” A comment that addressed how the materials were delivered was “Going through the activities was a good idea because we all come from different backgrounds with varying experience. When we go through the activities in groups, much like we would in our classrooms, we become aware of the problems the
students may experience.” A final comment was “The best thing about this workshop was actually going through the labs. This let me see what problems could arise.”

Because of the literature supporting the delivery of professional development and the fact that the PREPS design was for the participants to work through each activity as a student, I included interview questions with the six case studies dealing with the delivery of the workshop. Olivia shared that working through the materials as a student really helped her. She said this process increases the skill of the teacher to perform the activities. She said this strategy keeps the teacher from failing when utilizing the activities. She added that it makes a teacher ask, “Do I understand this?” before putting the material in front of the students. Valerie agreed that working through the activities helped increase her knowledge and skills. She said doing the work made the workshop interesting and not boring. Anita added that working through the activities like a student made the teachers well prepared to use the activities. Gloria said that she was able to use her PREPS notebook to make notes about what could go wrong. She loved working through the activities as a student. Karen and Robert also agreed that the delivery was a key strength of the workshop.

Discussion and interaction with the presenter was the next area on the evaluation form. The overall mean was 4.91 on a 5-point scale. These evaluation forms showed that five different presenters presented in the eighteen sites. Several comments included, “Excellent presenter” or “The presenter was very helpful in helping us prepare the students for the state test.” Several comments about having teachers as presenters were
included as well. For example, one participant wrote, “The most effective part of the series was having a presenter that is currently teaching Biology I. She knows the situations that we face and this was very helpful.” A last comment about this indicator was “The interaction between the presenter and the teachers was very beneficial. We were able to talk to a real teacher to help us share techniques and strategies.”

The case studies also agreed with the comments on the evaluation forms. According to Valerie, the presenter was a great facilitator that kept all the teachers on task while working through the activities. Valerie added that the presenter also shared her solutions and successes to some of the common problems encountered in the classroom. Anita added that the presenter was very helpful. The presenter shared additional activities that worked in her own classroom at the end of the sessions. She said this strategy added to the collaboration among teachers from other districts. They all brought their favorite classroom activity and shared on the last day. Olivia said everything about the workshop was wonderful, including the presenter. Olivia said she was so in awe of the presenter and how she knew so much! She said she remembers the patience of the presenter with her to explain basic biological principals as they worked through the materials.

The overall mean for small group work was 4.81 on a 5-point scale. The majority of the comments were extremely favorable regarding the group work with other teachers. One teacher wrote, “Interaction with other teachers was the most effective part of this series.” Another teacher added, “We were able to discuss the strategies as we worked through them. I obtained many new ideas and gained confidence to use the materials.”
Another comment was “The sharing of ideas with my colleagues was the most effective part of this series.” A few negative comments related to this indicator as well. One teacher noted, “We spent too much time on actually carrying out student activities. I would rather spend fewer days and just be given the activities. Everyone should know how to do each activity.” Another teacher wrote, “Great content, but just give us the handouts and let us spend one day discussing the test.”

The overall mean for units and other handouts was 4.95 on a 5-point scale, the highest rating overall. The participants made many comments on the evaluation forms about the high quality of the workshop materials. The comments ranged from praise of the content to the ease in which the materials could be used. One teacher wrote, “The most effective part was the labs which go along with the content. The labs given to us to use in our classes emphasize the content that students need to learn in Biology I.” Another teacher who was more specific about the content wrote, “The graphing unit was the most helpful for my students. I did not have enough resources in this area and the way the material is presented really made my students understand what to do.” Comments about the handouts included the following: “The handouts along with the discussion were the most effective part of the series.” Another participant noted, “Having the student handouts ready to use is just absolutely wonderful.”

The final category in the section was the overall effectiveness of the workshop. The participants rated this 4.88 on a 5-point scale. The open-ended question related to this category asked, “What was the most effective part of the series for you?” The responses provided details about the effectiveness of the workshop for the participants.
Many of the comments expressed how the materials helped in preparation for the Biology I Subject Area Test. One teacher wrote, “As an inexperienced biology teacher, I need all the subject area help I could get. The materials focusing on the state test are excellent!” Another teacher added, “This is the best workshop I have ever attended regarding curriculum and the state test. I have received some excellent information that will help my students prepare for the Biology State Test.” A final teacher noted, “These units, assessment strategies, and review guide will help students improve test scores.” Other comments were more general in describing the experience. One teacher wrote, “The most effective part of the series was receiving a new resource of information and a new (innovative) way of delivering old concepts.” Another teacher noted, “Every aspect of this workshop was helpful. Each time I went back to school I had new and different ideas that helped the students learn the concepts.” A final comment included, “I highly recommend this course for every Biology teacher, especially Biology I and new Biology teachers. It was great.”

The last page of the evaluation form began with two open-ended questions. The first question asked the participants for feedback in improving future workshops. The most common response was not to add anything and to “keep up the good work.” The second most common response was to include more units and activities. Other responses had to do with scheduling. Teachers seemed concerned that the sessions were taking them out of the classroom for five days. Several teachers asked that the workshop begin before school starts, which was the original design. Many teachers asked for the days to be shortened, but the same percentage of teachers asked that the days be lengthened so
more units could be discussed. Others asked that the two-day sessions be held on
Thursday and Friday and not during the week.

The second open-ended question asked whether the participants were interested in
a follow-up session, and if so, what type of content should be included. The participants
overwhelmingly (87%) answered this question with “yes.” The most common response
was “we need more teacher-created units from the other assessment strands.”
Suggestions of specific content included DNA and protein synthesis,
photosynthesis/respiration, classification, organic molecules, cell structure/function,
natural selection, organism diversity, genetics, and more on ecology. Some teachers
asked for practice tests and more discussion on the Biology I Subject Area Test. All six
of the case-study participants said they wished they could have a follow-up session a
couple of times each year. Karen also shared that her district asked PREPS for a follow-
up session. When the presenter came, no reference to the good strategies and design
remained from the first series. The presenter did a collection of various activities with
the teachers, and they jumped from topic to topic. Karen was very dissatisfied with this
follow-up activity. Olivia said, “I hope your study makes the PREPS group develop
follow-up sessions.”

The last section was a rating of strategies that teachers had tried in their
classrooms. The section asked the teachers to check the strategies tried and ended with a
question that asked the teachers to choose one strategy and describe their implementation
of that strategy. To obtain percentages of the responses, I tallied all of the checkmarks
per strategy and divided the checkmarks by the total participants who filled out this section.

This part of the PREPS Final Evaluation Form was unique for the Biology I series. The activities listed were those that dealt directly with the Biology I workshop. Two sets of workshop Final Evaluation Forms, totaling thirty-two forms, had to be deleted from this part of the analysis. In these workshops, the form used was for the U.S. History series; and this section had a big X marked through the strategies. The presenter in these two sessions had written a note explaining that the U.S. History forms were sent to the session by mistake. The dates of these workshops corresponded to the time period that the assessment coordinator was not working with workshop program. Four forms were blank for this section only. I deleted those four forms from this section of the analysis.

The highest-rated strategies included the use of graphing, simple tools, and selected-response items on tests. Having students construct graphs for classwork/experiments rated 96%, having students read and interpret graphs rated 98%, having students use simple tools in lab situations rated 96%, and used selected-response items on classroom assessments rated 92% (See Appendix D, Table 10). Several other strategies rated high with the participants. Used constructed-response items on classroom assessment rated 87%, having students make models to reinforce concepts rated 81%, used more diagrams and pictures on tests rated 79%, having students design and carry out their own experiments rated 77%, and using reading for information strategies when answering questions rated 74%. The lowest-rated strategies included the use of learning-
style cards, role play, and student conferencing. Having students use learning-style cards rated 40%, having students use role play to understand concepts rated 40%, and used conferences to help students improve work rated 43%.

The open-ended question that asked the teachers to pick one strategy and briefly describe the implementation received varied responses. Some teachers described using workshop materials exactly as presented, and others described taking a workshop strategy and going beyond the modeling. Many comments related to graphing. One participant shared, “I used some graphing before, but with the added resources I did a much more effective job with greater success.” Another comment was “I have used constructing graphs in class and reading graphs on tests. Student performance on the graphing test much improved.” Another teacher shared, “My students enjoyed working in small group to perform the experiments and construct graphs. They really got the graphing concepts. Thanks so much.” One teacher shared how he or she went beyond the workshop material, writing “The graphing unit went over so well, we began to construct graphs to show different stats from areas of their interest like football scores, etc. They just love it!”

Other comments related to classroom assessment. One teacher wrote, “My weekly test scores have improved because of the teaching strategies and the test construction material.” Another teacher shared, “I have used more diagrams and constructed response questions on my tests. It has raised the level of thinking of my students.” A final sample comment was “After using the open-ended response questions
on weekly tests, my students are not afraid. They were more confident in answering the questions on the state test.”

Conducting experiments and making models to reinforce concepts were also implemented. A few sample comments include, “My students used the sponge animal capsules to design an experiment. They were so excited to be able to use this.” “This workshop enriched my classroom. Models helped [my students] locate the parts and functions of animal cells.”

The results indicate that the participants in the PREPS Biology I workshops found the workshops to be effective. The numerical ratings that participants gave the workshops were supported by their comments and their answers to the open-ended questions. The ratings and comments indicate that these 159 teachers agree with much of what research shows about the content and process of effective professional development. According to the results, the content was rated as valuable because it was focused on student learning and improvement of student achievement. The participants also rated the presenter effective because he/she was a classroom teacher and also because of the knowledge shared. The participants rated the delivery of the workshop high. All but a few seemed to appreciate and value the active involvement of actually experiencing the learning strategies. The case studies also positively reinforced the methodology of active learning during the workshop sessions. The workshop was also effective in the scheduling of the workshop. The teachers gave a high rating to the design of using materials between sessions and reporting back results at the beginning of the next session several months later. The teachers that did not follow the initial schedule also
commented that this would have been a great experience. The scheduling is key to giving teachers the opportunity to try strategies in the classroom. The high number of strategies that the teachers actually reported using in their classrooms before the last session was also strong evidence that the schedule was effective. According to the case studies, the schedule made the difference in actually using the materials or putting the notebook on a shelf to gather dust.

Guskey (2002a) stated at this level the researcher focuses on whether the participants liked the experience, whether they felt their time was well spent, whether the materials made sense to them, whether the materials were useful, or whether the instructor was knowledgeable and helpful. Guskey advocated that measuring the initial participant reaction not only helps with the design and delivery of future programs, but it also serves as a valid prerequisite to higher-level evaluation results. At this level of Guskey’s evaluation, the PREPS Biology I workshop series was an effective professional development for the teachers involved.

Research question two: To what extent did the participants acquire the intended knowledge and skills presented in the PREPS Biology I workshop?

This research question related to the second level of evaluation as outlined by Guskey (2000). At this level the questions focused on measuring the knowledge and skills that the participants gained in the professional development experience (Guskey, 2002a). Guskey called this level of evaluation vital because it measures the relationship between the goals of the professional development and the level to which those goals
were achieved. He reminded researchers that if professional development participants do not improve their knowledge and skills, implementation will not be effective and student learning will not be improved. In addition, analysis of this information provided a basis for improving the content, format, and organization of the program.

I was able to answer this question by looking at responses to three instruments: the PREPS Final Evaluation Form, the questionnaire, and responses to the interviews. I obtained the quantitative data primarily from Part I of the questionnaire. I obtained the overall mean and percentage of each response from the fourteen indicators in Part I A that describe to what extent the workshop improved the participants’ knowledge. I repeated this procedure for the fourteen indicators in Part I B that describe to what extent the workshop improved the participants’ skills. Table 2 contains a list of the quantitative data. I collected the qualitative data from any statements written on the PREPS Final Evaluation Forms that addressed the teacher’s gain in knowledge and skill and any written comments on the questionnaire that pertained to gain in knowledge and skill. To provide triangulation for this research question, I also collected data from the six-case-study interviews.
TABLE 2. Mean Results of Participants’ Ratings of Part IA and Part IB on Biology I Professional Development Questionnaire

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Knowledge</th>
<th>Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student reading for information</td>
<td>2.00</td>
<td>1.98</td>
</tr>
<tr>
<td>Student constructing graphs</td>
<td>2.53</td>
<td>2.48</td>
</tr>
<tr>
<td>Student interpreting graphs</td>
<td>2.49</td>
<td>2.46</td>
</tr>
<tr>
<td>Student designing his or her own experiments</td>
<td>2.29</td>
<td>2.34</td>
</tr>
<tr>
<td>Student picking out experimental variables and controls from scenarios</td>
<td>2.53</td>
<td>2.47</td>
</tr>
<tr>
<td>Student making models to reinforce concepts</td>
<td>2.23</td>
<td>2.24</td>
</tr>
<tr>
<td>Student use of learning cycle cards</td>
<td>2.14</td>
<td>2.07</td>
</tr>
<tr>
<td>Student use of role play</td>
<td>1.80</td>
<td>1.86</td>
</tr>
<tr>
<td>Student answering open-response items</td>
<td>2.33</td>
<td>2.28</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items</td>
<td>2.26</td>
<td>2.32</td>
</tr>
<tr>
<td>Constructing open response items</td>
<td>2.33</td>
<td>2.35</td>
</tr>
<tr>
<td>Grading student work using a rubric</td>
<td>2.30</td>
<td>2.37</td>
</tr>
<tr>
<td>Using <em>Biology I Review Guide</em> for test preparation</td>
<td>2.60</td>
<td>2.58</td>
</tr>
<tr>
<td>Using professional reading to update practices</td>
<td>1.96</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Note: Participants used a 3 point rating scale delineated as follows: 3=affected my knowledge/skill to a great extent, 2=affected my knowledge/skill to some extent, 1=affected my knowledge/skill to little or no extent
From the questionnaire, the overall mean score for the extent to which the workshop had improved the participants’ knowledge was 2.27 on a 3-point scale. The overall mean score for the extent to which the workshop had improved the participants’ skill was also 2.27 on a 3-point scale. Very little difference exists in the individual ratings per indicator between improvement of knowledge and improvement in skill. If a teacher participant rated the knowledge portion of the indicator high, he or she also rated the same area on the skill portion high.

However, a few teachers deviated from that pattern. Approximately 15% of the teachers rated the knowledge portion low and the increase in skill portion very high. One teacher who followed this pattern indicated why by commenting, “I was already familiar with these strategies before attending these sessions.” Another teacher who rated the skill section very high wrote, “The workshop was very helpful in my ability to present this material to my students.” Karen explained her rating: She knew how to graph and thought she could teach graphing before the workshops. The PREPS materials made her teach graphing in a way that the students could learn, improving her skill as a teacher.

The highest indicator in both knowledge and skill categories was using the *Biology I Review Guide* for test preparation. The mean score for the extent to which the workshop improved the knowledge in this area was 2.60 on a 3-point scale, and the mean score for the extent to which the workshop improved the participants’ skill was 2.58 on a 3-point scale. The percentages for this indicator were as follows: 68% of the participants rated that knowledge had been increased to a great extent, 25% indicated that knowledge had been increased to some extent, and 7% rated that knowledge had been increased little
or to no extent. The PREPS Final Evaluation Forms contained several comments written about the *Biology I Review Guide* and gains in knowledge and/or skill. However, this material was only presented to the teachers on the final day of the workshop, which was the same day they had to fill out the evaluation form. The comments included, “The *Biology Review Guide* gave me knowledge of how to interpret each competency and objective from the framework to the state test.” Another comment was “I often wondered how to review my students for the test. This guide and the strategies for its use will help me and my students tremendously.” Olivia was not as familiar with the Biology I Subject Area Test and the framework objectives when she first began to teach science. She credits the workshop and especially the review guide for showing her what was important and what was not important. Now she understands how to prepare her students for the state test.

Other high indicators were the ones related to the experimental design unit. As for improvement in knowledge, participants identified constructing graphs (2.53 on a 3-point scale), picking out experimental variables (2.53 on a 3-point scale), and interpretation of graphs (2.49 on a 3-point scale) as the next three top strategies. The participants rated improvements in skill as follows: constructing graphs (2.48 on a 3-point scale), picking out experimental variables (2.47 on a 3-point scale), and interpretation of graphs (2.46 on a 3-point scale). The rating of improvement in skill was slightly lower in these categories. Participant comments on the questionnaire supported the gains in knowledge and skills. One teacher wrote,

> What helped me so much in this workshop was that I was taught ‘how’ to teach a concept. Some concepts taught at this workshop (experimental design unit) were
things that I was not comfortable teaching because I did not feel like I understood the material as well as I should have. PREPS gave me the confidence to teach this subject matter. I have hoped to be able to attend another workshop like PREPS but so far, not one has come close to meeting my needs.

Another teacher wrote, “This material gave me a new approach to teaching graphing and scientific methods. I have been so limited by the textbook. This has opened up a new world for me.” Another teacher commented, “This is the first professional training I have had in this area and it helped me understand.” Olivia said that this workshop was a lifesaver for her. She said the workshop increased her knowledge of biology greatly. She said she could have never taught the experimental design unit had it not been for graphing.

Another area in which teachers were asked to rate the improvement in knowledge and skills was classroom assessment. In these areas the increase in knowledge and skill was as follows: Students answering open-response items (knowledge, 2.33 on a 3-point scale; skill, 2.28 on a 3-point scale), constructing open-response questions (knowledge, 2.33 on a 3-point scale; skill, 2.35 on a 3-point scale), grading student work using a rubric (knowledge, 2.30 on a 3-point scale; skill, 2.37 on a 3-point scale), and constructing enhanced multiple-choice items (knowledge, 2.26 on a 3-point scale; skill, 2.32 on a 3-point scale). In this case the participants rated the skill gains slightly higher than the knowledge gains except for one area—having students answer open-response items, which was slightly lower. Comments from the PREPS Evaluation Form included, “This has helped me understand how to write my own classroom questions and set classroom assessment goals” and “I have re-evaluated the tests that I have previously given and added more application multiple-choice and open-ended questions.” One teacher also
wrote, “I learned how to make a rubric more ‘real’ for my students. This has helped me prepare my students for the test.” Karen added that she now writes almost all of her own test questions. She said she had never thought about doing this before the PREPS training. She added we must use good assessment techniques to see if students are really learning. She also began using rubrics after the PREPS workshops. She said that the PREPS workshop increased her knowledge and skill in all of the assessment areas.

The lowest-rated areas were using professional reading and using role play. For the using professional reading strategy, the mean score for the extent to which the workshop improved the knowledge in this area was 1.96 on a 3-point scale, and the mean score for the extent to which the workshop improved the participants’ skill was 2.02 on a 3-point scale. One comment from the PREPS Final Evaluation Forms was, “The journal articles had nothing to do with the state test. This is what we need to focus on.” Karen said that the workshop made her realize how important it was to keep current in the teaching field and that the only way to do this is by reading professional journals. Olivia added that professional reading is stressed in her National Board process. After the PREPS training and the National Boards process, she is very aware of the importance of this strategy.

For the using role play strategy, the mean score for the extent to which the workshop improved the knowledge in this area was 1.80 on a 3-point scale, and the mean score for the extent to which the workshop improved the participants’ skill was 1.86 on a 3-point scale. One questionnaire comment was “I had never thought about role play until the PREPS workshop. Going through the activity gave me the confidence to try this with
cell division. I have now used it in other classes for other topics.” Olivia rated the use of role play high for both increased knowledge and skill. She uses it today with her students. Anita, on the other hand, rated this strategy “little or to no extent” and does not use it today. One difference between these two teachers was the fact that Olivia actually worked through the activity with the presenter and Anita did not.

The aggregated data indicate that the PREPS Biology I workshop was effective in improving the knowledge and skill of the 71 workshop participants who returned the questionnaire. The rating for both knowledge and skill for all indicators was 2.27 on a 3-point scale. This rating indicated that all participants rated the workshops as having impacted their knowledge and skill at least to some extent. The numerical ratings that participants gave the workshops were supported by the comments of the case-study participants. These results also align with what research shows about the gain in knowledge and skill and effective professional development. According to the results, the workshop increased the participants’ knowledge of the Biology I Subject Area Test and classroom assessment practices. The literature described effective professional development as that which focuses on student achievement in both the classroom and in assessment. The content areas received high ratings in knowledge and skill gains because they were grounded in student learning practices and matched essential standards tied to the subject. A last factor in the teachers’ improving knowledge and skill levels was having the participants actively participate in the learning process throughout the workshop. This delivery method was also rated high in research question one. The case studies also positively reinforced all three of these factors during the interviews.
Guskey (2000) called the second level of evaluation vital because it measures the participants’ learning. He noted that if professional development sessions do not improve the participants’ knowledge and skills, implementation will not be effective and student learning will not be improved. At this level of Guskey’s evaluation, the PREPS Biology I workshop series was an effective professional development for the teachers involved.

Research question three: What organizational characteristics and structures were in place to support teacher change in the schools of the participants in the PREPS Biology I workshops?

The third level of Guskey’s (2000) professional development evaluation gathered information on organizational support and change. Organizational variables could be key to the success of using new learning tools or can hinder or prevent success. Questions at this level focused on the organizational structure in terms of whether the program aligned with the organization’s mission and goals, whether administrative support was available, whether the program affected the organization climate and procedures, and whether resources to implement the new learning activities were made available (Guskey, 2002a).

Part III of the questionnaire was designed to obtain information from all participants about this research question. For the quantitative data, I calculated the mean from the ten indicators that described the school support system. The last two indicators asked the participants to rate themselves as to their confidence in teaching biology and whether they readily try new teaching strategies. For all indicators, I tallied and calculated the frequencies and percentages for each response (see Table 3).
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Percentage (%) of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aligned with school mission, goals and objectives</td>
<td>4.70</td>
<td>74  23  3  0  0</td>
</tr>
<tr>
<td>Organization structure (schedule, curriculum) is conducive to teaching</td>
<td>4.35</td>
<td>55  31  9  3  2</td>
</tr>
<tr>
<td>Administration, faculty work together to improve student learning</td>
<td>4.35</td>
<td>52  35  8  5  0</td>
</tr>
<tr>
<td>Atmosphere exists that encourages educators to try new instructional practices</td>
<td>4.26</td>
<td>57  26  5  11  1</td>
</tr>
<tr>
<td>Recognizes that learning about best practices is never finished</td>
<td>4.28</td>
<td>52  34  6  6  2</td>
</tr>
<tr>
<td>Ready access to expertise when Implementation problems occur</td>
<td>3.24</td>
<td>35  20  26  19  0</td>
</tr>
<tr>
<td>Resources required to implement new practices are available</td>
<td>3.78</td>
<td>31  37  14  17  1</td>
</tr>
<tr>
<td>I have sufficient time to plan for instruction</td>
<td>3.41</td>
<td>19  36  13  30  2</td>
</tr>
<tr>
<td>Time and opportunity are available to collaborate with colleagues</td>
<td>3.34</td>
<td>14  41  15  27  3</td>
</tr>
<tr>
<td>Teachers are recognized and rewarded for successes with students</td>
<td>3.39</td>
<td>20  33  18  24  5</td>
</tr>
<tr>
<td>I have a high level of confidence to teach the content of Bio I</td>
<td>4.65</td>
<td>64.5 35.5 0 0 0</td>
</tr>
<tr>
<td>I readily try new teaching strategies that may benefit my classroom</td>
<td>4.60</td>
<td>63  35  0  2  0</td>
</tr>
</tbody>
</table>

Note: Participants used a 5 point rating scale delineated as follows: 5=strongly agree, 4 = agree, 3=neither agree nor disagree, 2=disagree, 1=strongly disagree
For the qualitative data, I also documented any written responses on the questionnaire that pertained to organizational support. Interviews and observations with the six case study participants yielded more in depth information about this research question. For this section I will discuss the rating of each indicator in a separate paragraph with additional evidence from the case study participants. The indicators are arranged from the highest mean score to the lowest in the descriptions.

The highest-rated indicator asked the participants whether the content of the Biology I workshop was aligned with the school’s mission, goals, and objectives. The mean score for this indicator was 4.70 on a 5-point scale. As a further breakdown, 74% of the participants marked that they strongly agree, 23% marked that they agree, and 3% marked that they neither agree nor disagree. Five of the six case studies rated this indicator 5 on a 5-point scale. Anita, who rated this indicator high, explained that the goals of the PREPS workshops were also the goals of her school—to tie the curriculum, instruction, and assessments to the state frameworks. Karen explained her high rating in the interview, emphasizing that her school aligns curriculum and student achievement both vertically and horizontally and that the PREPS materials helped the Biology I horizontal curricular alignment in that the materials directly related to classroom improvement. She added that the scientific method and graphing unit was applicable to all sciences. Karen also said mastery at one level helps the students be better prepared for other science courses in the vertical alignment. Anita’s overall rating of this section was 4.67, and Karen’s rating was 4.58 on a 5-point scale. Robert rated the overall section low (3.8 on a 5-point scale) but rated this indicator high. He discussed that his school
had hired a curriculum coordinator this year to help tie together the alignment of curriculum, instruction, and assessment. Olivia, who rated this section lower than any other case study (3.25 on a 5-point scale), said that the PREPS material was wonderful but that she rated this indicator 4 because her school’s missions, goals, and objectives looked great on paper, but she did not think they were being carried out in practice. For the six schools represented in the case study, all have a curriculum coordinator for the district, and two of the six said that this position had resulted from subject-area testing becoming high stakes.

The second highest-rated indicator related to the organizational structure of the school in terms of length of class time, scheduling of classes, and curriculum offerings. The teachers were asked whether the organizational structure of the school was conducive to teaching using the strategies modeled in the Biology I workshops. The mean score of this indicator was 4.35 on a 5-point scale. This indicator was tied for the second-highest rating in this category. In a more detailed breakdown, 55% of the participants marked that they strongly agree, 31% marked that they agree, 9% marked that they neither agree nor disagree, 3% marked that they disagree, and 2% marked that they strongly disagree. Again, five of the six case-study participants rated this indicator 5 on a 5-point scale with Olivia rating it 4 on a 5-point scale. The scheduling of the school day was mentioned in the questionnaire. One teacher wrote, “Time is a big factor. We’re on the rotating block schedule. I feel that this hurts our 9th and 10th graders, as they need daily instruction to reinforce the skills.” Karen, one of the case studies, also reporting being on the rotating or alternating block schedule and that this
schedule works well at her school. She remarked that she uses the five to ten minutes between the bell and the tardy bell for "pre-bell activities." This strategy gives the students a chance to reflect on what they did during the last class period. She said these questions help the students remember where they were two days earlier and help get them on track to continue learning about the current biological topic. Gloria reported that her school is also on a 4-by-4-block schedule and said that she absolutely loves the time she has with the students. She said she varies the activities throughout the period to keep the students engaged. Anita reported that her school returned to the 7-period-day schedule this year. She said she had a difficult time adapting to the shorter time from the previous 4-by-4-block schedule but that she was adjusting. Anita added that felt that the change was good for her students. They seem to work better with a shorter class period. All the other case studies are on the 7-period-day schedule and have been for the past several years. Robert indicated that he has plenty of time to work with his students and explore concepts in his teaching. Scheduling does not appear to be a problem with any of the case study participants.

The last topic mentioned in this indicator was the curriculum offerings for the schools. All of the schools now offer a course called Science Skills and Reasoning. Four of the six case-study participants teach this course, which is designed as a pre-biology class for those students who have made poor grades in middle-school science courses. The case-study participants who teach this class think that this class has helped the lower-performing students prepare for Biology I. However, Robert had a different view. Robert now teaches more Science Skills and Reasoning classes than Biology I classes.
He said his school is putting students into the Science Skills and Reasoning class if they pass the Biology I class but fail the Biology I Subject Area Test. He is asked to prepare these students for the test, but all students in his classes are not taking the Biology I Subject Area Test. He added that the pressure for the students to pass the state test is tremendous. He feels that he is under constant scrutiny due to his students’ test scores.

A third indicator, which was rated the same as the previous indicator, asked the teachers whether the administration, faculty, and staff of the school work together to improve student learning. The mean score of this indicator was 4.35 on a 5-point scale. The percentage of results was 52% of the teachers strongly agree, 35% agree, 8% neither agree nor disagree, and 5% disagree. Four of the case studies rated this indicator 5 on a 5-point scale. Karen reported that she had very strong leadership from her administrators. Her school just completed a “Schools That Work” evaluation, and Karen was a part of the preparation team. She said her administrators are fantastic and very supportive. Karen added that “the school values the time of their teachers” and works hard to support teachers. Robert also rated this indicator 5 on a 5-point scale. He said he felt overall he had a great administration with good leadership. Anita also rated her school high in this category. Even though she has a new principal and a new science-department chairperson this year, she feels that she has support from her administration to do her job. Valerie rated this indicator 5 on a 5-point scale. She also has a new principal this year. She said she feels that they work together because they have department meetings each Monday and staff development on Wednesday afternoons. The Wednesday-afternoon sessions begin around 1:00 p.m. after an early dismissal of the
students. Sometimes the training focuses on discipline; sometimes the focus is on writing across the curriculum; and sometimes the focus is on classroom management. When asked if these types of sessions meet her needs as a teacher, Valerie said, “Yes, I guess [they do]. This is what we do as a district.” Gloria rated this indicator 4 on a 5-point scale. In her interview Gloria was extremely positive regarding her school leadership. She feels she has the full support of her administrators. Olivia rated this indicator 3 on a 5-point scale. She said that her principal is new to the school this year. In fact, Olivia shared that her school has had four different administrators in five years. She added that the administration does not work with the teachers to improve instruction, but most of the teachers strive to improve instruction on their own. Olivia also told a story of her evaluation process for this school year. She serves on the evaluation committee that set the process for the administrators and teachers to follow. The process was supposed to involve three steps: a drop-in visit, a formative evaluation visit, and a summative evaluation visit. She had her summative evaluation visit from the principal a week prior to our interview; however, Olivia had not had the first two visits. She was supposed to have her follow-up session within two days after the evaluation, but a week later she still had not had this meeting. She said she did not feel supported by her administration.

The next highest-rated indicator asked the teachers whether the school recognizes that learning about best practices in the teaching profession is never finished. The mean score of this indicator was 4.28 on a 5-point scale. In a more detailed breakdown, 52% of the participants marked that they strongly agree, 34% marked that they agree, 6% marked that they neither agree nor disagree, 6% marked that they disagree, and 2% marked that
they strongly disagree. A comment from the questionnaire stated, “It is hard to learn about best practices now. Our funding for professional development training and attending regional and national conferences has been totally cut.” Gloria rated this indicator 5 on a 5-point scale. She eagerly shared information about the new reform program that her school will focus on for the next five to six years. The program is called “First Things First.” Consultants are taking school data on graduation rates and dropout rates and providing proven strategies to the faculty that will improve these areas. The consultant group is also analyzing the school’s curriculum and trying to add rigor to it. Gloria is one of the lead teachers in this initiative and also has just been named to the Mississippi Biology I Teacher Committee. She feels the district superintendent nominated her because she has continually strived for improvement in her classroom. When asked if she and other teachers could attend professional development sessions outside the school, Gloria answered that to her knowledge no one had been sent to any sessions other than those relating to her district’s initiatives. She feels that her district would allow her to attend any session that would help in her classroom; however, she had not attended any regional or national science teachers’ conferences. Karen also rated this indicator high and shared that most initiatives for teacher improvement have come through the district for this year. Karen also has not attended any science teacher conventions during the year; however, she said that any teacher would be supported if he/she asked to go. Anita, Olivia, and Robert told a different story. They said that if they wanted to attend any workshop or convention, either on a regional or national level, they would have to pay their own expenses due to budget cuts. Robert added that he also
would have to take a personal day to attend a professional meeting. Olivia said she is
currently working toward her National Board certification and that she has had to take
personal days to attend sessions with others going through the process. She said a group
of teachers get together on the weekends, but occasionally they have to meet during the
week. She said she has received no support from her district in this initiative.

The indicator that rated fourth overall described the school atmosphere and the
encouragement of educators to try new instructional practices. The mean score of this
indicator was 4.26 on a 5-point scale. The percentages of results were as follows: 57%
of the teachers strongly agree, 26% agree, 5% neither agree nor disagree, 11% disagree,
and 1% strongly disagree. A comment from the questionnaire stated, “If your test scores
are good, the principals don’t care. If you drop in scores, then you can’t try anything
new. They want you teaching to the test and nothing else.” Karen rated this indicator
high (5 on a 5-point scale). Karen’s school has hired the MWTI to work with them on a
regular basis on “Reading and Writing across the Curriculum.” She said in the science
areas they work once a month during a long block of time during the day. The focus of
this program is to implement successful strategies to improve instruction. She said she
incorporates this material with the PREPS materials to design the best possible lessons
for her students. She loves the reading and writing strategies and saw many of the same
activities modeled in the PREPS training. Robert also rated this indicator high. His
school is concerned about test scores and has recently implemented a WOW Biology
Program. WOW stands for “Workshops on Wednesdays” and is designed for any student
to stay after school and review topics in biology. The students usually review topics
using innovative techniques such as playing games and using role-playing activities. Olivia rated this indicator a 4 on a 5-point scale. Olivia worked with another teacher to write a grant; and while administrators did not oppose their plans to use the grant money to build an outdoor classroom, they also showed no appreciation for their efforts. Olivia utilizes this area as much as possible. She takes her students to the outdoor classroom to collect data and write observations.

The next group of indicators rated overall lower than the numerical value assigned in the “agree” or “strongly agree” parameters. The indicator that asked the teachers whether resources to implement new practices are available in the school had a mean score of 3.78 on a 5-point scale. In a more detailed breakdown, 31% of the participants marked that they strongly agree, 37% marked that they agree, 14% marked that they neither agree nor disagree, 17% marked that they disagree, and 1% marked that they strongly disagree. The biggest factor across all case studies was the recent budget cuts that have impacted the schools greatly. Only two of the case-study teachers rated this area 5 on a five-point scale, Karen and Anita. Karen currently has lab fees to supplement her school’s science budget. This practice has been ongoing for years, and she has not seen any differences in obtaining resources for her classroom. Anita told a similar story except her school does not ask the students for lab fees. She said her Educational Enhancement Funds (EEF) supplied by the state were very low this year, but the school funds were the same. She does not know how her district is funding the science labs, but she has what she needs for the classroom. Valerie rated this indicator 4 on a 5-point scale. Like Anita, her classroom supply money is the same, but her EEF funds have been
cut drastically. Robert rated this indicator 3 on a 5-point scale. He said he did not order many supplies but allowed the other biology teachers to order extra for his students. Olivia rated this indicator 2 on a 5-point scale. She said in the past she received $2,000 to order supplies for her room, in addition to her EEF money. Today she does not receive any money from the district and also has experienced cuts to her EEF money. She currently uses her own money to buy supplies to conduct classroom activities. She said she utilizes nature and the outdoor classroom for supplies as often as possible.

The indicator, having sufficient time to plan for instruction, had an overall mean of 3.41. In a more detailed breakdown, 19% of the participants marked that they strongly agree, 36% marked that they agree, 13% marked that they neither agree nor disagree, 30% marked that they disagree, and 2% marked that they strongly disagree. All case-study teachers have a daily planning period, even Karen who is on alternating block schedule. She said she has at least 50 minutes a day to plan instruction. Gloria and Anita both rated this indicator 5 on a 5-point scale. Gloria, being on the 4-by-4-block schedule, said she has plenty of time to plan and organize supplies for classroom activities. Anita said she misses the block time for planning, but because she has shorter lessons each day, organizing her lessons does not take as long. Robert rated this indicator 4 on a 5-point scale but admitted that he often uses his planning period to go to the field house to check on softball matters. Olivia rated this indicator 2 on a 5-point scale. She said she wishes she had more time to plan instruction. She also wishes she could plan instruction with her colleagues, but currently none of the other science teachers have the same planning period as Olivia.
The indicator, teachers are recognized and rewarded for successes with students, had an overall 3.39 mean. In a more detailed breakdown, 20% of the participants marked that they strongly agree, 33% marked that they agree, 18% marked that they neither agree nor disagree, 24% marked that they disagree, 5% marked that they strongly disagree. This indicator rated lowest among the case studies and next to the lowest in the entire population. No case study rated this indicator 5 on the 5-point scale. Karen was one of two teachers who rated this indicator 4 on a 5-point scale. Karen said that her school has corporate sponsors who help in student and teacher recognition and that for the first time the school organized a large ball this year to show appreciation to faculty. She said that the school also recently expanded a “Teacher and Student of the Month” program. She also said the school recognizes students with award nights in the spring, but this is the first year that the school has tried harder to include teachers. Anita, Gloria, Robert, Valerie, and Olivia shared that their schools only recognize Star Students who then select a Star Teacher each year. Robert shared that students have award banquets and recognition, but these banquets seldom recognize teachers. Olivia, who rated this indicator 2 on a 5-point scale, said that she and her co-teacher were nominated for a Governor’s Award. However, her school had not acknowledged the nomination at all. She said the local papers had printed a few stories with pictures of the outdoor classroom, but that no one in the district had even thanked them for the contributions that they had made to the school campus and to the students. Valerie rated this indicator 1 on a 5-point scale when she filled out her questionnaire last year; however, she said in the interview that she would rate this slightly higher for this school year. Valerie’s district gave the
students and faculty a huge barbeque, along with a “day off,” for school improvement. She said that teachers were not individually recognized, but the students were rewarded for improving test scores. Upon further research, the average test scores in Biology I for Valerie’s school improved from 317.9 to 332.2.

The indicator, I have time and opportunity to collaborate with my colleagues, had an overall mean average of 3.34. The number of participants who marked strongly agree was 14%, 41% of the participants marked agree, 15% of the participants marked neither agree nor disagree, 27% of the participants marked disagree, and 3% of the participants marked strongly disagree. Valerie and Anita rated this indicator 5 on a 5-point scale. Valerie said that they met by departments each Monday after school. She said that she had support from her science chairperson and felt that this collaboration helped her. Anita expressed that her rating had changed from last year when she filled out the questionnaire. She said that they used to have weekly faculty meetings and meet in departments. She explained how the science department worked together as a team to share activities and plan instruction. However, this year the school has a new principal and a new science department chairperson. It is different, but she still thinks they will eventually work together the way they did last year. Karen told a different story. Karen rated this indicator 2 on a 5-point scale. She explained that they have faculty meetings after school at least once every three weeks. She said it was not a productive time to share ideas at all. It was more “business like” instead of a sharing opportunity. She does not get time to work with her colleagues on issues that would help her teaching. Gloria and Olivia, who also rated this indicator 2 on a 5-point scale, had the same stories. They
said that they enjoyed the PREPS workshops because they got a chance to share activities with each other. While they discuss things with their colleagues at school, it is not the same. Olivia added that she does work with other teachers, but that they have to make the time to work together. Robert rated this indicator a 4 on a 5-point scale. He shared that his school currently has professional development meetings every Wednesday after school. However, he usually has to go to the field house to take care of athletic business.

The lowest-rated indicator asked if teachers have ready access to expertise when implementation problems arise or difficulties in instruction are encountered. The overall mean score from the questionnaire was 3.24. The percentage of participants who marked strongly agree was 35%, 20% of the participants marked agree, 26% of the participants marked neither agree nor disagree, and 19% of the participants marked disagree. Anita and Karen both rated this indicator 5 on a 5-point scale. Both said that they have access to community-college resources and professors when needed. However, both Anita and Karen said that they would have to initiate the contact. Karen added that she probably would not call anyone unless something drastic happened. Olivia rated this indicator 4 on a 5-point scale. She said that she has a botanist from the extension service who serves as a consultant for the outdoor classroom project. She said she constantly learns from the consultant and that the students also love working with him. Gloria rated this indicator 2 on a 5-point scale. She said that she did not have a resource that she would consider an expert, but that it would be nice. She added that she could probably find someone if she needed them, but there was not one available. She added that her expertise was from searching the Internet for classroom activities.
In the same section of the questionnaire in which participants rated the organizational structures and policies, the participants also rated their level of confidence to teach Biology I and their willingness to try new teaching strategies. The indicator that asked the teachers whether they had a high level of confidence in their ability to teach the content of Biology I had a mean score of 4.65 on a 5-point scale. In a more detailed breakdown, 64.5% of the participants marked that they strongly agree, and 35.5% marked that they agree. No negative responses appeared in this indicator. The case study participants followed the pattern with four of the six case-study participants rating this indicator 5 on a 5-point scale and two rating themselves 4 on a 5-point scale. Olivia was one of the teachers who rated her confidence 4 instead of 5 on a 5-point scale. She said that because she taught home economics and special education for so many years, she still found it difficult to think of herself as an accomplished biology teacher. She loves to teach students and loves the subject, but she often thinks she could learn more and be more proficient. Robert, who was selected as a case study as a teacher who implemented PREPS materials to a limited extent, rated himself 5 on a 5-point scale. He explained that he loved to teach and was only there because of the students. However, he admitted that while he felt he was capable of being a very good teacher, his coaching duties sometimes interfered with his success in the classroom. He added that he felt that he was tolerated in the classroom because of his success on the field.

The last indicator in this section asked the teachers whether they would readily try new teaching strategies that might benefit their classroom practice. The mean score from all participants who filled out the questionnaire was 4.60 on a 5-point scale. In a more
detailed breakdown, 63% of the participants marked that they strongly agree, 35% marked that they agree, and 2% marked that they disagree. The participants rated this indicator higher (4.60 vs. 4.26) than the previous indicator that asked if the school encourages teachers to try new instructional practices without fear of criticism. Five of the six case-study participants rated this indicator 5 on a 5-point scale. The one person who rated this indicator 4 on a 5-point scale was Robert, who readily admitted in the interview that he did not implement the PREPS material as he should have. Olivia, who rated herself lower in the previous indicator, said she was willing to try activities that would work for her students. She said that she had heard several presentations about different strategies that were not reasonable for her students and was not willing to try them. She said that while she will try new activities, she is also selective in her implementation of new practices. Olivia did utilize most of the PREPS materials in her classroom not only because they were proven to work with students, but also because she saw a need for the using the strategies in her classroom.

The aggregated data indicate that the participant’s schools have characteristics and structures in place to support teacher change. The descriptive data from the questionnaire indicate that the participants perceive that the content of the PREPS Biology I workshop is aligned with the missions, goals, and objectives of their respective schools. The data indicate that the organizational structure of the high schools in which the participants teach is predicated to a great extent by the high-stakes Biology I Subject Area Test. The information from the case studies supports the rationale that the alignment is centered around student performance on the Biology I Subject Area Test.
Only Karen mentioned that her school is working on vertical and horizontal curriculum alignment and that any of the PREPS material could be used in sciences other than Biology I. The curriculum alignment and curriculum offerings in science link to the Biology I Subject Area Test, and support from administration to try new teaching strategies and to gain more professional knowledge is linked directly to student performance on the Subject Area Test. Recognition is primarily for students and is planned after the students perform well on the Subject Area Test.

The data also show that while participants perceive that the school staff works together to improve student learning, the teachers primarily related this support to the administration. Further analysis shows that one case-study teacher, Karen, who implemented the workshop materials to a high extent, has great support from her administration while another teacher who also implemented the materials to a high extent, Olivia, had much less support from her constantly changing administration. On the opposite side, the two teachers who implemented the materials to a limited extent said they have very good leadership from their administration. This indicator reinforces the literature that the single most important factor in student achievement is the classroom teacher.

No difference exists in the type of schedule a school utilizes as far as teachers being able to adapt and use the strategies modeled in the Biology I workshops. However, time was a factor in sufficient planning and collaborative planning for the teachers. Some teachers make their own time and take advantage of other situations to work with colleagues. The lowest-rated area was making expertise available to teachers. Very few
teachers had this luxury, and the case-study participants who rated this indicator high had to initiate the contact themselves. The school did not provide an expert for them.

The impact of cuts in statewide educational funding also emerged from answers to this research question. The area in which funding cuts have had the most impact is in having funds to purchase resources for the teachers’ classrooms. Having materials to implement strategies is very important in a science classroom. Funding also has implications for providing collaborative planning time for teachers, encouraging continued professional growth through quality staff-development sessions, and providing access to additional expertise for the teachers.

One area rated very highly was the level of confidence in teaching Biology I. Strongly agree (64.5%) and agree (35.5%) were the only responses marked. Literature supports the results that teachers must have high confidence levels to continually improve practices. Another highly rated indicator was whether teachers would readily try new teaching strategies that might benefit their classroom practice. The mean score from all participants who filled out the questionnaire was 4.60 on a 5-point scale. The participants rated this indicator higher (4.60 vs. 4.26) than the previous indicator that asked if the school encourages teachers to try new instructional practices without fear of criticism. These results imply that a successful teacher is willing to do what it takes to teach students regardless of whether the principal shows support, if the funding is available, or if extra time is allotted for planning and collaboration. Even though the teacher is the key to a successful classroom, having administrative, collegial, and financial support makes the job much easier (Guskey, 2000).
Research question four: To what extent did the participants in the Biology I workshop use the units and strategies in their classrooms?

The fourth level of Guskey’s (2000) professional development evaluation examined the participants’ use of the new knowledge and skills. The central question focused on whether what the participants learn makes a difference in their professional practice. This information must be gathered using indicators that reveal both the degree and the quality of implementation of the new practices. However, unlike levels one and two, information at level four cannot be gathered until sufficient time has passed from the completion of the program. Enough time must pass to allow participants to adapt the new ideas and practices to their setting (Guskey, 2002a).

I collected data for research question four primarily from Part II of the questionnaire and the case-study interviews. However, the scheduling of the PREPS Biology I workshops allowed for some earlier collection of data as well. The workshops were scheduled so that participants attended sessions, learned about effective teaching strategies and saw many such strategies modeled. They returned to their classrooms and attempted implementation before the next scheduled meeting. Thus, the PREPS Final Evaluation Forms also allowed the participants to check the strategies that they had implemented into the classroom from the first four sessions of the workshop. The forms also asked participants to describe the implementation of the strategies that they had used. These initial forms provided useful information. The time frame between the participants attending the workshop and receiving the questionnaire allowed a comparison between
the initial strategies tried during the workshop and a final evaluation much later after the conclusion of the workshop.

Participants indicated the level of implementation on Part II of the questionnaire. They used a 5-point scale with the 5 representing “use as a regular part of classroom practice when appropriate,” 4 representing “use often,” 3 representing “use infrequently,” 2 representing “tried but have discontinued use,” and 1 representing “have never used.”

The questionnaire asked participants to rate fifteen strategies and activities emphasized in the entire PREPS training sessions. These strategies were slightly different from the PREPS Final Evaluation Form, which only asked for strategies from the first four days of the training. Two open-ended questions also included in the questionnaire collected further explanation as to the way the materials were implemented. The overall mean score for the fifteen strategies from the seventy-one participants who returned the questionnaire was 4.05 on a 5-point scale. The strategies implemented most frequently were using the *Biology I Review Guide*, constructing enhanced multiple-choice test questions, having the students answer open-ended test questions, having students interpret graphs, and having the students read for information. The two lowest-rated strategies were in the mitosis/meiosis units, having students use learning cycle cards and having students use role play. I have grouped the rest of this section into the strategies that were used more frequently and into the units or topics that they addressed in the workshop. For complete summary of this data, see Table 4 below.
### TABLE 4. Mean and Percentage Results of Participants’ Ratings of Part II on Biology I Professional Development Questionnaire

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Percentage (%) of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student reading for information</td>
<td>4.28</td>
<td>Implementation: 42 R 48 O 9 I 0 D 1 N</td>
</tr>
<tr>
<td>Student constructing graphs</td>
<td>4.21</td>
<td>Implementation: 37 R 47 O 16 I 0 D 0 N</td>
</tr>
<tr>
<td>Student interpreting graphs</td>
<td>4.28</td>
<td>Implementation: 37 R 54 O 9 I 0 D 0 N</td>
</tr>
<tr>
<td>Student designing his or her own experiments</td>
<td>3.89</td>
<td>Implementation: 22 R 40 O 35 I 2 D 1 N</td>
</tr>
<tr>
<td>Student picking out experimental variables and controls from scenarios</td>
<td>4.13</td>
<td>Implementation: 30 R 54 O 16 I 0 D 0 N</td>
</tr>
<tr>
<td>Student making models to reinforce concepts</td>
<td>4.04</td>
<td>Implementation: 29 R 46 O 25 I 0 D 0 N</td>
</tr>
<tr>
<td>Student use of learning cycle cards</td>
<td>3.09</td>
<td>Implementation: 11 R 28 O 38 I 6 D 17 N</td>
</tr>
<tr>
<td>Student use of role play</td>
<td>3.19</td>
<td>Implementation: 16 R 22 O 40 I 9 D 13 N</td>
</tr>
<tr>
<td>Student answering open-response items</td>
<td>4.46</td>
<td>Implementation: 57 R 33 O 10 I 0 D 0 N</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items</td>
<td>4.46</td>
<td>Implementation: 55 R 36 O 9 I 0 D 0 N</td>
</tr>
<tr>
<td>Constructing open response items</td>
<td>4.27</td>
<td>Implementation: 40 R 48 O 12 I 0 D 0 N</td>
</tr>
<tr>
<td>Grading student work using a rubric</td>
<td>4.09</td>
<td>Implementation: 35 R 42 O 20 I 3 D 0 N</td>
</tr>
<tr>
<td>Using <em>Biology I Review Guide</em> for test preparation</td>
<td>4.51</td>
<td>Implementation: 66 R 19 O 15 I 0 D 0 N</td>
</tr>
<tr>
<td>Using professional reading to update knowledge</td>
<td>3.91</td>
<td>Implementation: 28 R 43 O 24 I 0 D 5 N</td>
</tr>
<tr>
<td>Constructing another teaching unit using material from this workshop series</td>
<td>3.88</td>
<td>Implementation: 31 R 42 O 18 I 2 D 7 N</td>
</tr>
</tbody>
</table>

Note: Participants used a 5 point rating scale delineated as follows: 5=use as a regular part of classroom practices when appropriate, 4 = use often, 3=use infrequently, 2=tried but have discontinued use, 1=have never used
The strategy most implemented was using the *Biology I Review Guide*. The mean score for this strategy was 4.51 on a 5-point scale. As a further breakdown, 66% of the participants marked that they use this strategy regularly, 19% marked that they use it often, and 15% marked that they use it infrequently. This strategy was not part of the PREPS Final Evaluation Form because it was part of the last day’s session. One comment from the questionnaire was “I have used the *Biology I Review Guide* over and over. It has made an impact on both my unit tests and the state test.” Another participant wrote, “I use the *Biology I Review Guide* for test preparation. The guide was well-designed and organized in alignment with the state curriculum framework.” Five of the six case-study participants rated this 5 on a 5-point scale. Robert rated this strategy 4 on a 5-point scale. He said that he uses the review guide right before the state test. He said he never thought about using it as a review for his nine-weeks’ test. Valerie said the review guide was very valuable for her students. Anita said she had a 98% pass rate for her students on the Biology I Subject Area Test. She said all PREPS materials helped, but especially the review guide. She said it was a treasure. Gloria added that the *Biology I Review Guide* was often used in her district as a remediation tool for those who did not pass the state test the first time.

The next group of strategies was those dealing with classroom assessment practices. Constructing enhanced multiple-choice items had a mean score of 4.46 on a 5-point scale. As a further breakdown, 55% of the participants marked that they use this strategy regularly, 36% marked that they use it often, and 9% marked that they use it infrequently. One respondent wrote on the questionnaire, “I am writing more and more
enhanced multiple-choice questions for my weekly tests. This training made me aware of the limitations of the recall questions so often found in our textbooks.” A comment from the PREPS Final Evaluation Form was “I have re-evaluated the tests that I have previously given and added more enhanced, application type questions.” Four of the six case-study participants rated this strategy 5 on a 5-point scale. Gloria and Karen said they take the questions that come with their textbooks and try to rewrite them. Gloria also mentioned using questions from the Biology I Review Guide on her weekly tests. Olivia said she mixes her test questions: She writes what she can and uses good questions from the ancillary documents. Anita said the workshop made her realize that she could write her own test questions. She shared some enhanced multiple-choice questions with me during the interview. They were exactly like the models used in the workshop materials. Robert and Valerie rated this strategy 3 on a 5-point scale. Both said they use standardized tests that come with their textbook in the classroom.

Having students answer open-response items on tests was the next strategy. The mean score for this strategy was also 4.46 on a 5-point scale. As a further breakdown, 57% of the participants marked that they use this strategy regularly, 33% marked that they use it often, and 10% marked that they use it infrequently. Another strategy directly related to students’ answering open-response items was teachers’ constructing open-response items. The mean score for this strategy was somewhat lower, 4.27 on a 5-point scale. As a further breakdown, 40% of the participants marked that they use this strategy regularly, 48% marked that they use it often, and 12% marked that they use it infrequently. A comment from the questionnaire was “In each unit of study, I try to come
up with a suitable open-response question for the material studied. This allows my students to practice writing out what they know instead of selecting from a list of answers.” Karen rated both of these strategies 5 on a 5-point scale. She said that she used student critiquing of open-ended questions to help the students understand the rubric and the scoring process. She added that this strategy improved her students’ ability to write a complete answer in a more concise way. Gloria also rated this strategy high and puts open-response questions on her tests. She is amazed at how well her students can write responses. She is convinced that when a student can write out an explanation of a concept correctly that the student fully understands the concept. Robert rated both of these strategies 3 on a 5-point scale. He said he did not write any of his test questions but did use some short answers from his textbook’s ancillary materials.

The last strategy in student assessment practices was grading student work using a rubric. The mean score for this strategy was 4.09 on a 5-point scale. As a further breakdown, 35% of the participants marked that they use this strategy regularly, 42% marked that they use it often, 20% marked that they use it infrequently, and 3% marked that they have tried it but have discontinued use of this practice. A comment from the questions was “I often use ‘peer grading.’ We read aloud the answers to open-response questions. Students are able to assign grades with surprising accuracy.” A second response from the questionnaires was “As a result of this workshop, I have developed and use rubrics to assess student projects. These rubrics have assisted my students in improving the quality of their work.” Another respondent wrote, “I have students grade sample open-ended responses using the rubric. Then I show them the actual grade. This
Gloria shared a similar experience in her classroom. She rated this strategy 5 on a 5-point scale. She uses sample student papers as demonstrated in the workshop on an overhead projector. She lets the students grade them by using the rubric. She says this strategy helps her students understand the scoring process and know what they need to do to write a good response. Karen explained that she made up rubrics for projects, posters, and classroom presentations. She always details how a poster or project would be graded before the students presented the work. She said if teachers follow the rubric, students seldom question the grade assigned.

The next group of strategies was those dealing with the experimental design and graphing unit. Five strategies were associated with this one unit. This unit aligns directly with the four objectives under competency one in the Mississippi Science Framework. This competency and its four objectives comprise 21% of the Biology I Subject Area Test under the Nature of Science assessment strand.

The first strategy was having students read for information. The mean score for this strategy was 4.28 on a 5-point scale. As a further breakdown, 42% of the participants marked that they use this strategy regularly, 48% marked that they use it often, 9% marked that they use it infrequently, and 1% marked that they have never used this strategy. One comment from the PREPS Final Evaluation Form was “I type my notes in a way that my students must read to find answers. This practice cuts down on time spent in class writing notes. It also ensures that students have correct information to study.” Another comment from the final evaluation form was “Reading for information is the best way to get students to try to read the text and understand what is expected of
them.” A comment about this strategy from the questionnaire was “I found that by reading for information, my student understanding has greatly improved.” Another comment was “I am a big proponent of reading and was so glad that this was stressed in a science workshop.” Karen rated this strategy 5 on a 5-point scale. She said that she enjoyed requiring students to read for specific information. She said she creates questions for every unit that require her students to actually read to obtain information needed for the answers. Gloria also rated this strategy high. She used the read-for-information strategy the day I visited her. She said it helps her students read and understand the information before “just writing something down that is not correct.” Valerie rated this strategy 4 on a 5-point scale. She says that reading is a big problem for her students, but she has tried the strategy outlined in the PREPS materials, and it helps her students. Olivia rated this strategy 4 on a 5-point scale. She said she uses the reading for information but not in every unit. She said that it is an effective tool if used properly.

The next two strategies deal with graphing; having students interpret graphs, and having students construct graphs. The mean score for students interpret graphs was 4.28 on a 5-point scale. As a further breakdown, 37% of the participants marked that they use this strategy regularly, 54% marked that they use it often, and 9% marked that they use it infrequently. The mean score for students’ constructing graphs was 4.21 on a 5-point scale. As a further breakdown, 37% of the participants marked that they use this strategy regularly, 47% marked that they use it often, and 16% marked that they use it infrequently. A comment from the PREPS Final Evaluation Form was “The activity involving the use of paper towels was very different from what I had used previously.”
My students love the way this new lab works and the graphing has become easy for them to do.” Another comment from the final forms was “The graphing activities have really helped. I was so surprised at the number of students who couldn’t graph and could not read a graph.” There were numerous comments from the questionnaire. One comment was “I enjoy using graphing techniques. My students seem to understand graphing after using this material.” An example of an extension of the activity was “We use the PREPS material first on graphing. We have expanded this material by collecting data on student body weight. They construct graphs from this information.” Olivia rated both of these strategies 5 on a 5-point scale. In the interview Olivia shared with me that she uses the experimental design unit exactly as presented, and the unit works for her students every year. She said she would not change a thing. She plans to use data collected from her outdoor classroom as additional practice for her students. Anita also rated both of these strategies high. She said she also uses every bit of these materials in her classroom, and she also shared her lesson plans with me from earlier in the school year. Karen also rated these strategies high. She added that what makes them so great is that they engage all students, from low achievers to high achievers. She said the lower-level student can construct a graph and feel good about the accomplishment. She said the upper level student can construct a more creative graph and still feel good about the accomplishment. Robert rated these strategies 4 on a 5-point scale. He said he uses the graphing handouts and also supplements them with handouts from the books. Robert admitted that he does not do the paper towel experiments every year but that when he did use them, the students enjoyed performing the activity.
The next strategy asked students to pick out experimental and control variables from experimental scenarios. The mean score for this strategy was 4.13 on a 5-point scale. As a further breakdown, 30% of the participants marked that they use this strategy regularly, 54% marked that they use it often, and 16% marked that they use it infrequently. One comment shared from the PREPS Final Evaluation Form was “I had never thought about making up scenarios and asking the students to pick out the variables. This is a wonderful idea and really helped my students understand experimental design better.” Comments from the questionnaire include the following: “I use this material in every science class that I teach. It is excellent. It made me design my own scenarios for practice in my physical science classes;” “My students have really benefited from using the scenarios and picking out variables. It also helps them on standardized tests, such as ACT.” Karen rated this strategy 5 on a 5-point scale. She explained that what made this strategy so valuable was that the strategies were on grade level and were attainable for all students. While this skill was difficult for some students to achieve, it matched the state frameworks and was attainable for all students. Robert rated this strategy 4 on a 5-point scale. He said that the students struggle with this part of the PREPS unit but that the worksheets outlining the scenarios were very valuable for his students. He said they improve in this area each year. Anita rated this strategy 5 on a 5-point scale. She said her students are better designers of experiments after reading through the scenarios. While admitting it is difficult for the students to do these activities, she said that the students have a better idea of all aspects of good experimental design when they complete the tasks.
The last strategy in the experimental design unit was having students design their own experiments. The mean score for this strategy was 3.89 on a 5-point scale. As a further breakdown, 22% of the participants marked that they use this strategy regularly, 40% marked that they use it often, 35% marked that they use it infrequently, 2% marked that they tried this strategy but discontinued use, and 1% marked that they have never used this strategy. A comment from the PREPS Final Evaluation Form was “The students worked in groups to design experiments and were helpful to each other in discussing all the variables needed.” Another comment was “My students had to design an experiment, carry it out, graph the results, and present the findings to the class. They learned so much from each other in this process.” Valerie rated this strategy 4 on a 5-point scale. She said she used the sponge animal capsules every year. She said her students get excited and try to use various water temperatures in carrying out the experiment. Karen rated this strategy 5 on a 5-point scale. She said she made the paper towel and absorption experiment an inquiry-type lab. The students had to design how they would collect data to determine which paper towel would absorb the most water. She said the students love the activity and come up with some innovative ways of measuring water absorption.

Two of the three activities used in the mitosis and meiosis unit rated lowest of all the strategies. Having students use learning cycle cards was the lowest, and having students use role play was the second-lowest strategy implemented according to the questionnaire results. The other strategy used in the unit rated much higher. The mean score for having students make models to reinforce concepts was 4.04 on a 5-point scale.
As a further breakdown, 29% of the participants marked that they use this strategy regularly, 46% marked that they use it often, and 25% marked that they use it infrequently. Comments from the PREPS Final Evaluation Form included the following: “One strategy I use in several areas is constructing models. We have made models of DNA, stages of mitosis, karyotypes, food webs and protein synthesis.” One comment from the questionnaire was “I adapted the mitosis pipe-cleaner model to cells. I’m not sure if it is the building of the cell or the report that they have to do, but the students are doing much better on the test.” All of the case-study participants said they knew about modeling before the workshops but were interested in the pipe-cleaner model of mitosis. Karen, who rated this strategy 4 on a 5-point scale, said she does use models in teaching biology but does not use them in the mitosis area each time. Robert rated this strategy 5 on a 5-point scale and said his students love to build models. Anita rated this strategy 4 on a 5-point scale and said she used model building before she attended the PREPS workshop, and it was a good way to reinforce concepts.

A low-rated teaching strategy was having the students use role play to understand concepts. The mean score for this strategy was 3.19 on a 5-point scale. As a further breakdown, 16% of the participants marked that they use this strategy regularly, 22% marked that they use it often, 40% marked that they use it infrequently, 9% marked that they tried this strategy but discontinued use, and 13% marked that they have never used this strategy. Several positive comments about role play were made even if it did rate low overall as a teaching strategy. One teacher used an extra page attached to the PREPS Final Evaluation Form to describe how she took her students to the football field to act
out mitosis. She had a student to video the action from the press box. The students were excited to get back into the classroom to see the process on the VCR. The teacher was amazed at how real the students moving around looked to the actual process on time-lapse video. Another comment written on the questionnaire was “I use both paper models and have students role play certain processes. It has really helped the students’ understanding of the harder concepts.” An additional comment from the questionnaire was “The role play of mitosis was so good that I have used role play in other areas of study.” The case-study teachers collectively rated this strategy low. Anita said she did not use this strategy at all partly because she did not go through it in the workshop training. Robert said he was just not a role-player type of person. Olivia rated this strategy 4 on a 5-point scale. She had her socks in the plastic container in the bookshelf. She said weather permitting she did take her students outside and use this strategy for her instruction of the cell-division process. She said she knows this activity helped her students understand the complex subject of cell division better. Karen also rated this as 5 on a 5-point scale. She said that she used this strategy on a regular basis and that it added to the students’ understanding of the process. She said once a student becomes a chromosome and sees what chromosomes do while dividing, that student usually gets the stages correct on the test.

The last strategy in this unit was using the learning-cycle cards. This was the lowest rated strategy on the questionnaire. The mean score for this strategy was 3.09 on a 5-point scale. As a further breakdown, 11% of the participants marked that they use this strategy regularly, 28% marked that they use it often, 38% marked that they use it
infrequently, 62% marked that they tried this strategy but discontinued use, and 17% marked that they have never used this strategy. More teachers marked that they had never used this activity than any other strategy. As with the role play, several comments were written on the questionnaire explaining how teachers used this strategy with great results. One teacher wrote, “Students color the learning cycle cards, label them, and write the name of the phase on the back. The students work in pairs to quiz each other until they understand the concepts fully.” Another teacher wrote, “I use the mitosis and meiosis learning cycle cards each semester that I teach Biology I. My students’ understanding of these very difficult processes has increased. My students have done very well on the state test.” Karen said she learned her lesson this year when she did not use learning-cycle cards at first when teaching her students about cell division. She said she had a 50% pass rate on her first test. She said she got out the cards and let her students work through the activity, and they pulled up the scores to a 75% pass rate on the retest. She said that by the time they took the semester exam, they had gone through the processes again and that the overall passing rate was much higher. Karen said she was trying to do things like the other teachers in her school even though she knew how valuable these cards could be for student understanding when used correctly. She said she will not make the mistake she made this year again.

The last two strategies involve teachers using professional reading to update knowledge and teachers’ constructing another teaching unit using material from the workshop series. Neither of these strategies was on the PREPS Final Evaluation Forms. The “using professional reading” strategy was introduced the last day of the workshop.
The mean score for using professional reading to update knowledge was 3.91 on a 5-point scale. As a further breakdown, 28% of the participants marked that they use this strategy regularly, 43% marked that they use it often, 24% marked that they use it infrequently, and 5% marked that they have never used this strategy. A comment from the questionnaire was “I constantly gain new ideas by utilizing professional reading. I read two journals on a fairly regular basis because the PREPS training made me see the need for this practice.” Another comment from the questionnaire was “I am going through the National Board process. I now understand the importance of professional reading. It makes sense why this was part of the PREPS training.” Olivia is the only case study currently going through the National Board certification process. She rated this strategy 4 on a 5-point scale. She says that while she sees the importance of professional reading, she often does not have the time to utilize this strategy to the fullest. Karen also rated this strategy 4 on a 5-point scale. She shared that she also understood the importance of professional reading and how valuable it can be for the teacher. She said that she often picks up a journal of high school teaching strategies and sees a neat idea but often does not take the time to design her own lesson and incorporate it into her teaching.

The mean score for constructing another teaching unit using materials from this workshop series was 3.88 on a 5-point scale. As a further breakdown, 31% of the participants marked that they use this strategy regularly, 42% marked that they use it often, 18% marked that they use it infrequently, 2% marked that they tried this strategy but discontinued use, and 7% marked that they have never used this strategy. One
comment from the questionnaire was “I used the workshop information to enhance every competency taught in Biology. I found that having students design experiments and pick out variables did much to enhance their comprehension in other areas. PREPS is a great tool for teachers.” Another comment was “I use graphing, graph interpretation and chart reading/construction as much as possible in every unit.” A third comment was “We role play cell organelles in my Science Skills and Reasoning class. I got the idea from the mitosis role-play activities.” Finally one teacher shared, “I have used many of the PREPS activities in my Biology class at the community college where I teach at night. This is good stuff.” Karen rated this strategy 5 on a 5-point scale. She said she wrote a good unit in ecology and incorporated the ecology activities shared in the workshop. She said she did not know if this “counted” because the teachers were asked to do this on the last day of the workshop but that her students really seemed to learn from her unit. Anita rated this strategy 4 on a 5-point scale. She pointed to the DNA ornaments on the tree and said that she incorporated model-building strategies wherever they would help students learn. Robert rated this strategy 3 on a 5-point scale. He said he must not be a very smart teacher because he used his textbook more to teach students. He said he would like to incorporate more things but that he just could not come up with enough creative ideas.

The results indicate that the participants in the PREPS Biology I workshops found the workshops to be effective. The numerical ratings that participants gave the workshops were supported by their comments and their answers to the open-ended questions. The ratings and comments indicated that these 71 questionnaire
respondents agree with much of what research shows about the content and process of effective professional development. According to the results, the content was valuable because it was focused on student learning and was focused on the improvement of student achievement. The participants also appreciated and valued the active involvement in experiencing the learning strategies. The case studies also positively reinforced the methodology of active learning during the workshop sessions. The teachers also rated similar strategies high for implementation, knowledge, and skill gains. Using the Biology I Review Guide, improving classroom assessment practices, and using the experimental design unit were rated high not only in both knowledge and skill but also in classroom implementation.

Further analysis shows that the practices that the 159 teachers initially implemented as reported on the PREPS Final Evaluation Form aligned with the questionnaire results obtained from the 71 teachers several years later. I added the questionnaire results in the “use regular” and “use often” categories for the nine similar strategies. Table 5 shows the results of the comparison between the two periods of time and the reported implementation percentages.
TABLE 5. Comparing Implementation Results in the PREPS Biology I Workshop: Strategies Implemented by Teachers as Reported on Final Evaluation vs. Questionnaire

<table>
<thead>
<tr>
<th>Strategy</th>
<th>PREPS Final Evaluation Percentage Used</th>
<th>Questionnaire Percentage Used Regular Use + Often Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having students read for information</td>
<td>74%</td>
<td>90%</td>
</tr>
<tr>
<td>Having students interpret graphs</td>
<td>98%</td>
<td>91%</td>
</tr>
<tr>
<td>Having students design experiments</td>
<td>77%</td>
<td>62%</td>
</tr>
<tr>
<td>Having students make models</td>
<td>81%</td>
<td>75%</td>
</tr>
<tr>
<td>Having students use learning cycle cards</td>
<td>40%</td>
<td>39%</td>
</tr>
<tr>
<td>Having students use role play</td>
<td>40%</td>
<td>38%</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items</td>
<td>92%</td>
<td>91%</td>
</tr>
<tr>
<td>Constructing open-ended items</td>
<td>87%</td>
<td>88%</td>
</tr>
</tbody>
</table>

These data show that the teachers who used materials during the workshop training are consistent with the self-reported results found in the questionnaire. The trend was that the activities used initially were also the activities continued years later.
Guskey (2002a) stated that level-four evaluation focuses on whether or not the participants used the new knowledge and skills. The data indicated that the participants used the majority of the strategies in their professional practice. At this level of Guskey’s evaluation, the PREPS Biology I workshop series was an effective professional development for the teachers involved.

Research question five: Did the teaching strategies and classroom units affect student performance or achievement?

The fifth level of Guskey’s (2000) professional development evaluation looked at the student learning outcomes. The central question focused on whether the program benefited students in any way, which is the ultimate goal of professional development. However, linking professional-development efforts to improvements in student outcomes is not an easy task because any factor can influence student learning. Analysis of level-five information can guide improvements in all aspects of professional development, including program design, content, implementation, and follow-up sessions. Guskey added that this information can also be used to estimate whether the professional development is cost-effective and empowers professional developers to make what they do count (Guskey, 2002a).

I collected data for research question five primarily from Part IV of the questionnaire and the case-study interviews. Participants indicated the level of implementation on the questionnaire, using a 5-point scale with the number 5 representing “strongly agree,” number 4 representing “agree,” number 3 representing “neither agree nor disagree,” number 2 representing “disagree,” and number 1
representing “strongly disagree.” The questionnaire asked participants to rate two statements describing the impact of the PREPS Biology I workshop on student achievement in the classroom and on the Biology I Subject Area Test. Analysis of the classroom test scores and the scores from the “Nature of Science” assessment strand on the Biology I Subject Area Test obtained from the case studies also yielded aggregated data to answer question five. The PREPS experimental design unit was intended to address the entire Nature of Science assessment strand that is currently measured on the Biology I Subject Area Test (Bridges, personal communication, July 7, 2000). This assessment strand comprises 21% of the entire test.

The mean score for the first indicator from the questionnaire, content of PREPS Biology I workshop positively impacted the student’s classroom performance, was 4.40 on a 5-point scale. In a more detailed breakdown, 52% of the participants marked that they strongly agree, 38% marked that they agree, 8% marked that they neither agree nor disagree, and 2% marked that they disagree (see Table 6).
TABLE 6. Mean and Percentage Results of Participants’ Ratings of Part IV Biology I Professional Development Questionnaire

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean</th>
<th>Percentage (%) of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of PREPS Bio I workshop has positively impacted my students’</td>
<td>4.40</td>
<td>52  38  8   2   0</td>
</tr>
<tr>
<td>classroom performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content of PREPS Bio I workshop has positively impacted my students’</td>
<td>4.26</td>
<td>40  47  11  2   0</td>
</tr>
<tr>
<td>performance on the Biology I SAT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Participants used a 5 point rating scale delineated as follows: 5=strongly agree, 4 = agree, 3=neither agree nor disagree, 2=disagree, 1=strongly disagree

The questionnaire did not contain a specific open-ended question to collect data about this topic; however, participants wrote several comments about classroom impact in their answers to the strategies used question. Most of the comments from the questionnaire described the experimental design unit and/or the mitosis unit with the impact it had on student understanding. One teacher wrote, “I use all of this material in teaching scientific methods. I have seen a greater understanding and better test scores because of this material.” Another teacher wrote, “The experimental design unit has impacted my students greatly. They have gained skills in graphing, experimental design, and reading because of this unit.” Another teacher noted, “I have implemented the graphing unit that has proven to be very effective in my classroom from this workshop.” Anita said her students loved the PREPS graphing and scientific methods material. She noted that her students were very engaged in the classroom when using the materials. Anita said, “The way you work through the activities help the students learn the material.” A comment
from the questionnaire about the mitosis unit was “I use the mitosis activities in my Biology II class. The students’ did so much better on my test.” Olivia is convinced that the mitosis learning-cycle cards, along with the worksheets, help her students master the complex subject of mitosis. She says that her students do not perform as well on the classroom tests as they do with graphing, but she knows it helps her students understand the material.

Other comments discussed the use of open-ended questions and rubric grading. One teacher wrote, “As a result of this workshop, I have developed and used rubrics to assess student projects. These rubrics have assisted my students in improving the quality of their work.” Another teacher wrote, “I begin the year by teaching students how to use a rubric. I let them practice writing open-ended responses to questions on my weekly tests and they score each others’ papers. It has really helped their understanding.” Anita also shared an experience in which she gives her students the sample papers from the PREPS workshops and lets them score the papers using a rubric. She said one question is all it takes for them to understand how to write an open response to a question. She also puts open-ended questions on her classroom assessments several times throughout the year.

The case-study participants also discussed the impact on the students’ achievement at the classroom level. Olivia says she still uses the entire PREPS experimental design unit as it is written. She shared that most of her students pass the test on graphing the first time and understand the material. Olivia showed me her grade book with her graphing test scores and her experimental design test scores. For the total
of all of her students, 88% made a passing score on the graphing test; and 82% made a passing score on the scientific method test (see Table 7). Anita had a similar story. She, too, uses all of the PREPS materials for the same unit. Anita had a 70% passing rate on the graphing test and 85% passing rate on the scientific methods. Anita contributed the lower graphing test scores to first-test jitters. She has asked students to graph in other units and is convinced that they understand the concept. Robert estimated that he used the PREPS material about 80% and used his textbook about 20% to teach graphing and experimental design. When asked for the numbers that passed his test on these topics, he reported that he had a 63% passing rate on graphing and a 59% passing rate on the scientific method test. Gloria reported her classroom results as 86% of her students passed the graphing test, and 90% passed the scientific methods test. Karen has made her classroom assessments match the enhanced multiple-choice type of test. She likes for her students to write out responses as well. She says that her classroom assessments are challenging, and her tests are not the “memorizing type” of biology test. Her classroom results were as follows: 80% of her students passed the graphing test, and 84% passed the scientific methods test. Table 7, below, reports the teachers’ classroom test scores and the percentage of PREPS materials used for the 2004–2005 school year.
### TABLE 7. Classroom Test Scores from Case Studies on Experimental Design Unit

<table>
<thead>
<tr>
<th>Case Study Teacher</th>
<th>Percentage of Students who Passed Test</th>
<th>Percentage of PREPS Material Used in Instruction</th>
<th>Percentage of Students who Passed Test</th>
<th>Percentage of PREPS Material Used in Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anita</td>
<td>70%</td>
<td>100%</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>Karen</td>
<td>80%</td>
<td>95%</td>
<td>84%</td>
<td>100%</td>
</tr>
<tr>
<td>Valerie</td>
<td>82%</td>
<td>95%</td>
<td>73%</td>
<td>100%</td>
</tr>
<tr>
<td>Robert</td>
<td>63%</td>
<td>80%</td>
<td>59%</td>
<td>80%</td>
</tr>
<tr>
<td>Gloria</td>
<td>86%</td>
<td>100%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>Olivia</td>
<td>88%</td>
<td>100%</td>
<td>82%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The mean score for the second indicator from the questionnaire, content of PREPS Biology I workshop positively impacted the students’ performance on the Biology I Subject Area Test, was 4.26 on a 5-point scale. In a more detailed breakdown, 40% of the participants marked that they strongly agree, 47% marked that they agree, 11% marked that they neither agree nor disagree, and 2% marked that they disagree.

Participants wrote several comments on the questionnaire regarding how the PREPS workshops had led to success on the Biology I Subject Area Test. One teacher wrote, “I regularly use a PREPS unit on ‘Scientific Methods’ in my class. It helps my students’ scores on the MS Biology I Subject Area Test.” Another teacher added, “The review portion for the end of the year state test has helped my students. Our scores have improved.” Another teacher commented, “My Biology I SAT scores reflect my student’s
increase in knowledge on graphing and scientific methods.” Several teachers commented about the impact of the *Biology I Review Guide*. A teacher wrote, “I made a practice test from the *Biology Review Guide*. Our test scores improved last year.” Another teacher added, “My students Biology I Subject Area Test scores have improved due to [the review guide]. I use it faithfully.”

The case studies also correlated the PREPS materials to student success on the Biology I Subject Area Test. Karen explained that the way the materials are presented helps her students on the test. Her students have told her that as they take the test, the activities come to mind, making it easier for them to answer the question. She is totally sold on the students’ performing activities. She added that the review helps her students organize the topics in their minds before the test. For the past two years, Karen’s school has scored above the state average in the Nature of Science assessment strand (see Table 8 below). Mississippi’s raw score average for the Nature of Science assessment strand was 10.0 for school year 2002–2003. The raw score average for Karen’s school was 10.8 for the same year. In the 2003–2004 school year, Mississippi’s raw score average for Nature of Science was 9.7. The raw score average for Karen’s school in this assessment strand was 10.6. Karen is not the only teacher teaching Biology I in her school, but she has shared the PREPS materials with the other teachers, and at least one other teacher has attended the workshop series. Another case study, Olivia, had similar results. Olivia implements the experimental design unit in her classroom exactly as presented in the workshop. She uses the review guide to review her students. Her school’s Nature of Science raw scores are 10.5 for school year 2002–2003 and 10.7 for school year 2003–
2004. Not only is her school above the state average for this assessment strand for both years, but also her school is above the district average as well. Olivia is the primary biology teacher at her school. Gloria’s school district has a different story. Her school has scored consistently below the state average for the past two years for the Nature of Science assessment strand. In 2002–2003, the school’s scores were 8.6; and in 2003–2004 the scores were 7.9. Gloria said she uses the PREPS materials faithfully in the experimental design unit. However, Gloria’s school scores are for two campuses in her town. According to the Mississippi Report Card for 2002–2003 (2003d), the enrollment of students who took the Biology I Subject Area Test for her school was 421. Gloria teaches approximately 76 students this year in her Biology I classes.

TABLE 8. Average Raw Scores in Nature of Science Assessment Strand on the Biology I Subject Area Test

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mississippi Average</td>
<td>10.0*</td>
<td>9.7</td>
</tr>
<tr>
<td>Gloria’s district**</td>
<td>8.6</td>
<td>7.9</td>
</tr>
<tr>
<td>Robert’s district**</td>
<td>10.5</td>
<td>9.7</td>
</tr>
<tr>
<td>Olivia’s school</td>
<td>10.5</td>
<td>10.7</td>
</tr>
<tr>
<td>Karen’s school**</td>
<td>10.8</td>
<td>10.6</td>
</tr>
<tr>
<td>Valerie’s school</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Anita’s school**</td>
<td>10.6</td>
<td>9.7</td>
</tr>
</tbody>
</table>

*Out of a possible 15, **Not the only teacher teaching in the school, N/A – scores not available from teacher
The descriptive data supported by teacher comments on the questionnaire and
testimonies from the case-study participants indicate that the teaching strategies and
classroom units positively affect student performance and achievement both in the
classroom and on the Biology I Subject Area Test. Teachers also indicated that the
materials also improved student achievement in science classes other than Biology I.
The results indicate that the seventy-one participants in the PREPS Biology I workshops
found the workshops to be effective for student improvement. All of the case studies
estimated that they use at least 80% of the experimental design unit in the classroom each
year as it was presented in the workshop. The case-study participants’ comments, along
with the classroom test scores, supported the numerical ratings that participants gave the
workshops. According to the results, the content was rated as valuable because it was
focused on student learning and improvement of student achievement.

Guskey (2002a) stated that at this level the researcher focuses on the impact on
students. The central question focused on whether the program benefited students in any
way. Analysis of level-five information could guide improvements in all aspects of
professional development, including program design, content, implementation, and
follow-up sessions. At this level of Guskey’s evaluation, the PREPS Biology I workshop
series was an effective professional development and played a part in the student
achievement in the classroom and on the Biology I Subject Area Test.

**Summary**

Based on the analysis of the quantitative and qualitative data collected for this
research study and applying the evaluation model for professional development proposed
by Guskey (2000), the PREPS Biology I workshop is an effective professional development. Research question one detailed the participants’ initial reactions to the PREPS Biology I workshop series. The participants who filled out the PREPS Final Evaluation Form considered it effective when they completed the sessions. The case-study participants also supported the quantitative data. For this research question, several factors contributed to the effectiveness of the workshops. One factor was that the content of the workshop was focused on student learning and was aligned to the curriculum frameworks. Another factor was the active involvement of the participants during the workshop delivery in working through the activities just as the students would in the classroom. A third factor was that the presenter of the workshops was an active classroom teacher who was able to share experiences with the other biology teachers. A fourth factor that contributed to the workshop’s effectiveness was that the workshop was on-going in its scheduling. This format provided teachers with the opportunity to return to the classrooms between sessions to try activities with their students. The teachers reported their success stories upon returning to the next session.

Research question two concerned the increase of the knowledge and skills of the workshop participants. The 71 teacher participants who returned the questionnaire rated the workshop effective in improving their knowledge of the instructional strategies and their skill in using the strategies. Again, the case-study participants supported the quantitative data. For this research question, several factors contributed to the effectiveness of the workshops. One factor was that the content of the workshop was focused on student learning and was aligned to the curriculum
framework. Another factor was that the content also focused on student assessment in the classroom and strategies for improvement of student achievement on the Biology I Subject Area Test. A third factor was the active involvement of the participants during the workshop delivery in working through the activities just as the students would in the classroom.

Research question three detailed the organizational characteristics that are needed to support teacher change at the school level. The main factor that contributed to the success of the workshops was that the content of the workshop was aligned to the schools’ missions and goals. This alignment was true for student learning, school curriculum, and the success rate of the Biology I Subject Area Test. Other factors that most impacted the success of the workshop were the teacher’s confidence in teaching the subject and the teacher’s ability and willingness to try new strategies when needed. Support is deemed desirable from the administration in the areas of leadership, financial matters, and time management. However, it is the individual teacher who impacts the classroom and ultimately student learning goals.

Research question four detailed the implementation of the workshop strategies and materials. The participants reported that they had successfully implemented many of the strategies that they had been taught and had seen modeled in the workshops. Again, the case-study participants supported the quantitative data. The implementation was aligned to the strategies that the teacher participants rated high for research question two, gain in knowledge and skills. Another factor was that the content of the workshop was focused on student learning and was aligned to the curriculum frameworks. A third
factor was that the content also focused on student assessment in the classroom and strategies for improvement of student achievement on the Biology I Subject Area Test. A fourth factor was the active involvement of the participants during the workshop delivery in working through the activities just as the students would in the classroom.

Research question five detailed the impact of the PREPS Biology I workshop on students in classroom performance and achievement. The 71 teacher participants who returned the questionnaire rated the workshop effective in improving student performance in the classroom and on the Biology I Subject Area Test. Again, the case-study participants supported the quantitative data. For this research question, several factors contributed to the effectiveness of the workshops. One factor was that the content of the workshop was focused on student learning. The content of the workshop also focused on student assessment in the classroom and strategies for improvement of student achievement on the Biology I Subject Area Test. The case-study participants also shared classroom test scores for students and also provided Biology I Subject Area Test data by assessment strands for the past two years. Although any success and improvement in scores cannot be solely attributed to the PREPS materials, a positive relationship exists between the use of the experimental design unit and student achievement in the classroom and on the Biology I Subject Area Test.
CHAPTER V
SUMMARY, CONCLUSIONS, RECOMMENDATIONS

The PREPS Biology I Subject Area Module was designed to provide teachers with curriculum pieces, teaching strategies, and assessment techniques to assist students in mastering objectives of the Mississippi Science Framework and the Biology I Subject Area Test (PREPS, 2004). This research has yielded data about the effectiveness of the PREPS Biology I workshop series. The quantitative and qualitative data collected from the PREPS Final Evaluation Forms and the questionnaire along with the data gathered from the six participants in the case studies have contributed to the answers for each research question. This chapter presents the findings and how these findings apply to the PREPS Biology I workshop and other professional development sessions. The first section of this chapter contains a summary of Chapters I, II, III and IV. The second section will contain the conclusions formulated after the analysis of the data. The third section of this chapter will give recommendations for planning and delivering professional development based on the results of this study.

Summary

Chapter I introduced this study of Biology I professional development series. Reasons why this study was so timely were detailed in this chapter. The background of subject area testing and accountability in Mississippi were explained. Federal and state
laws have mandated changes in schools for accountability of all students. The Biology I Subject Area Test became a high-stakes graduation exit exam for every student in Mississippi during the 2001–2002 school year. This chapter also introduced the non-profit organization called Program for Research and Evaluation for Public Schools, Inc. (PREPS). PREPS, was created to provide many services to its member school districts. In 1998, they developed a Subject Area Test Module that included a five-day Biology I Workshop series. This workshop series was created to provide member districts with the content, curriculum, and assessment techniques used in classrooms that have been successful in improving scores on the Biology Subject Area tests. The PREPS workshops were designed based on effective professional development research. The delivery, scheduling, and content were carefully structured to provide the teachers a valuable experience.

Chapter I also presented the purpose of this research study: to evaluate the PREPS Biology I Subject Area workshops using Guskey’s evaluation model as a guide in the process. The goal of this study was to use the initial evaluation forms from the completion of the original workshops between 1998 and 2001 and to further investigate the teachers’ knowledge, skills, organizational structure, and implementation of the workshop materials and strategies. Student achievement was also explored based on classroom experiences and assessment gains. Chapter I presented the five research questions that guided this study. A rationale for the study was formally presented along with the limitations of the study.
Chapter II included a review of the related literature concerning professional development. This literature review gave a synopsis of the role professional development has played in recent educational reform movements. Limitations of professional development were summarized. Delivery of professional development by lecture and treating teachers as passive learners were described. School context limitations outlined the fact that most teachers work in isolation, and do not have administrative support, do not have opportunities to collaborate with colleagues and do not have the time designated for effective professional development sessions. Most professional development sessions consist of a one-day session or a few hours after school. A last limitation was the lack of follow-up sessions for worthy topics and the lack of evaluations to see what works for teachers and what does not work.

From an opposite view, the literature review included factors of effective professional development. These factors were organized into context, content, and process standards recently published by the National Staff Development Council. As for context standards, the literature reveals that professional development should be continuous and on going in nature and should give teachers needed opportunities to practice and reflect on new learning situations. Teachers should work with administrators in planning their learning needs and the principal should provide teachers opportunities, time, money and external assistance to see that professional growth occurs for each teacher. Effective professional development should broaden content knowledge and skills of the teachers and strengthen teachers’ knowledge of how children learn. A successful way of accomplishing gain in knowledge and skill is for the teachers to
become active learners to experience the materials firsthand before teaching the students. Process standards can be accomplished by designing professional development sessions that focus on student learning and student achievement. Teachers are more willing to attempt to change practices if they think it will make a positive change in their classrooms. However, the literature is very clear that change in teacher practices must be approached carefully. Teacher’s must feel confident about the new practices and eventually take ownership of the change in practice. To support the changes, collaboration with other teachers is needed. The literature details that interaction with peers for learning opportunities is critical to teacher growth. Lastly, follow-up and evaluation of professional is needed to determine teachers’ ongoing needs of growth in the profession. The last part of the literature review detailed types of evaluations. The last section of the chapter describes Guskey’s five-level model of evaluating professional development.

Chapter III described the mixed-method design used to conduct this research. Both quantitative and qualitative techniques were used in this study. Validity and reliability issues were addressed by the design of the study, in the instruments used, and in the methods of gathering data. The participants in the study were the Mississippi Biology I teachers who completed the PREPS Subject Area Module between 1998 and 2001 and who are still actively teaching Biology I in the classroom. The instruments used to gather data contain both closed questions to collect quantitative data and open-ended questions to collect qualitative data. The instruments used in the study were the PREPS Final Evaluation Form completed at the end of the workshop sessions and the
questionnaire composed for this study. Six case study participants were selected from answers to the questionnaire to provide further information and to aid in triangulation for the data collected in the study. Data collection from the case study participants were obtained through interviews held in the teachers’ classrooms. Additional school documents and lesson plans were also tabulated. Analysis of the quantitative and qualitative data was completed and placed into categories. These categories were divided and subdivided and matched to each research question. Major themes were noted from the data and coded. Initial data and results were sent to a peer reviewer for collaboration.

Chapter IV described the actual study and the results. The six teachers who agreed to participate were introduced. The chapter also details each research question and details some of the data that led to the results. Research question one asked: How did the participants rate the effectiveness of the PREPS Biology I workshop? Based on the ratings from the PREPS Final Evaluation Forms and supporting evidence from the case study teachers, the participants found the workshops to be effective. The content was rated effective because it was focused on student learning and the improvement of student achievement. Other factors that contributed to the workshop’s effectiveness were the active learning of the participants during the workshop delivery; the presenter of the workshops was an active, successful classroom teacher; and the workshop was on-going in its schedule, giving teachers time to try strategies.

Research question two asked: To what extent did the participants acquire the intended knowledge and skills presented in the PREPS Biology I workshop? Based on the aggregated data from the questionnaire and the interviews with the six case study
teachers, the workshop improved the participants’ knowledge of the materials and the skill in using the instructional materials. The teachers rated this effective because the workshop was focused on student learning; materials were aligned to the curriculum frameworks; the content was also focused on student assessment; and the participants used active learning during the workshop delivery.

Research question three asked: What organizational characteristics and structures were in place to support teacher change in the schools of the participants in the PREPS Biology I workshops? There were five areas on the questionnaire rated highly. The teachers rated this effective because the workshop was focused on student learning; content was focused on student assessment and success on the Biology I Subject Area Test; and materials were aligned to the curriculum frameworks. Participants also indicated that they were confident about their ability to teach Biology I and were willing to try new strategies. The case study teachers also provided data to collaborate these results.

Research question four asked: To what extent did the participants in the Biology I workshop use the units and strategies in their classroom? The teachers again rated the content and strategies effective and had successfully implemented many of the strategies that they had seen modeled and had experience in the active learning design of the workshops. Other factors were that the content of the workshop was focused on student learning and was aligned to the curriculum frameworks, and many of the strategies were focused on student assessment in the classroom and student success on the Biology I
Subject Area Test. Interviews and observations from the case study teachers supported the results.

Research question five asked: Did the teaching strategies and classroom units affect student performance or achievement? The participants rated the workshop effective in this area. Again the workshop content was focused on student learning, assessment techniques, and student success on the Biology I Subject Area Test. The case study participants provided an average of classroom test score success and provided Biology I Subject Area Test data by assessment strands that supported these results.

**Conclusions**

The results of this research support several findings found in the literature about successful professional development. This study supports the literature that effective professional development must be continuous and on going throughout the school year. The schedule of the workshops was for five days, in which two were held before school started, two days held in late fall, and one day held in the spring. The teachers were given the opportunity to try new practices and bring back reflections on each practice to discuss with the group. Participants rated the schedule highly (4.67 on a 5-point scale) and the case study participants said it increased confidence in using the activities.

The results of this study supports the literature that effective professional development occurs when instructional methods used to promote learning with teachers mirror the methods to be used with students. The delivery of the PREPS Biology I workshops had a successful, experienced Biology I teacher presenting the instructional materials and strategies to the teacher participants. The teacher participants experienced
active learning by working through the lessons as if they were a student. The participants in the workshops rated the delivery (4.82 on a 5-point scale) very valuable and the case-study participants collaborated this result.

Another literature review finding is that effective professional development must increase the teacher’s knowledge and skill. This study supports the literature finding. By working through the strategies as active learners, the teachers were more likely to increase their knowledge and skill in the workshop. The teacher participants rated this section of the questionnaire highly (2.27 on a 3-point scale) and the case study participants supported the findings.

The review of the literature showed that teachers are attracted to professional development that focuses on student learning and achievement. The results of this study certainly support that finding. The highest rated strategies in the study were those involving the use of the *Biology I Review Guide* and the experimental design unit. Organizational structures and policies in the school are also focused on student learning and achievement according to the results of the questionnaire and through interviews with the case study teachers.

An important element of school organization is school goals and mission. The review of literature indicated that the school must have definite goals that are related to student outcomes and that effective professional development should mirror these goals. The results of the study support this finding. The participants and case-study teachers strongly agreed with this finding for the PREPS Biology I workshop.
Another component of school organization is the school leadership. This study supports the literature-review findings that the principal has a very specific role in the school’s professional-development program. However, the literature goes further to add that the principal should create new policies and structures that support all aspects of effective professional development. These policies and structures would include more time for teacher collaboration with peers, more time to plan effective lessons, and more classroom resources to implement new practices. The participants did not rate these areas as high according to this study.

This study also supported the literature-review findings that the principal is the instructional leader of the school. Teacher participants rated this indicator high, and the majority of the case-study teachers also validated this finding. The literature is clear that schools with successful professional development have strong leadership from the principal. These principals took an active part in talking with the teacher about new practices and worked with teachers to plan effective instruction. Very little evidence of the administrators and teachers working as partners to improve student learning was displayed in the case-study schools despite the fact that this collaborative effort is deemed desirable for effective professional development.

The literature review also shows that change in practice is often difficult and that teachers must have self-confidence in their teaching to be willing to change their teaching practices. This study supported this finding. Participants rated indicators pertaining to confidence in their ability to teach Biology I high on the questionnaire. The teachers also
gave a positive rating to an indicator that they would readily try new strategies that would benefit their classroom. Interviews with case-study participants supported this finding.

**Recommendations**

After the Guskey five-level model was applied, the results of this study indicate that the PREPS Biology I workshop series is an effective professional development. After careful analyzing of all data and drawing conclusions from that data, I have recommendations to further strengthen the PREPS Biology I Subject Area Test Module. The results of this study yield findings that can be generalized to all providers for effective professional development. The results of this study also suggest the need for further research.

I recommend that PREPS continue the five-day schedule for the delivery of this professional-development series. The timing of the workshop should be such so that the teachers will be allowed time to practice strategies with students between sessions and then reflect on that practice with peers during the next session. The original schedule was for the first two-day session be held before school starts, the next two-day session be held during the late fall/early winter of the school year, and the last day be held in the spring. This schedule gave the participants the time needed to implement the materials and strategies, which led to many teachers taking these practices and using them successfully in their classroom for the past several years. While having teachers out of the classroom is an issue, the results yielded from the participants in this study indicate that this schedule is valuable in learning new practices and in building confidence.
I recommend that PREPS keep the basic content of the Biology I Subject Area workshops the same but make a few modifications. The current module of training was developed in early 1998, and presentations began in the summer of 1998. This development and training took place before the 2001 *Mississippi Science Framework* was released to the school districts. All content of the PREPS Biology I workshop still aligns to the new framework, but the mitosis/meiosis cell unit contain activities relating to objectives that have been transferred into the genetics area of the current framework. I recommend a careful analysis and update of all materials and, if necessary, the redevelopment of the mitosis/meiosis unit and the addition of another unit in genetics. Because adding additional content could overload the current delivery plan, the extra content could require the development of a second phase of the workshop series. In this study the content and strategies of teaching were highly rated as a major strength of the workshop series. The materials do not need a drastic renovation but merely a minor fine-tuning of the content.

I recommend that PREPS provide follow-up training for these workshops in the districts. This request was found numerous times in two instruments: the PREPS Final Evaluation Form and the questionnaire. The teachers thought the original series was excellent. They asked for other units to be delivered in the same scheduling format in the future. The evidence in the questionnaire was powerful. The fact that the teachers participated in this workshop series between 1998 and 2001 and still responded so favorably about the workshop and strategies when asked in 2004 is very impressive. A follow-up session is recommended.
I also recommend that some type of electronic-mail correspondence be set up between the presenter of the workshop sessions and all the participants between the sessions. The teacher participants indicated that working with other teachers was yet another strength of the workshop series. The literature review emphasized that the teachers who collaborate with peers are more likely to implement strategies learned. A support system would strengthen the collaboration between the participants and the presenter; however, the presenter would need to take the lead role in initiating this support system with the participants.

I also recommend that PREPS use one evaluation form at the end of the Biology I workshop series. This study was limited to participants who experienced the workshop between 1998 and 2001. The evaluation form had changed after 2001 to a new format that did not collect the same information. The sessions can only be improved to meet teachers’ needs if the information collected is consistent through the years. I suggest the careful analysis of the current form compared to the older form used by the MWTI to ensure that the form is adequate in collecting vital information.

Because one case study was sent to the workshop twice and two similar statements were found on the PREPS evaluation forms, I recommend that PREPS utilize careful registration procedures for the workshop series. School districts need assistance in identifying those who have attended the series and those who have not. A simple check of the database of previous workshop participants and a call to the school to let principals know that they have registered a teacher who has already attended would be helpful. This procedure would also be beneficial for the teachers who leave one district and begin teaching in a different district.
Most importantly, I highly recommend that PREPS add an overview of effective professional development to the workshop series. The data from this study clearly indicate that many teachers still perceive professional development as something that is “done to them” instead of something that they should guide and mold for their own professional growth. If teachers are made aware of the true purpose of professional development, perhaps the one-shot lectures or two-hour Wednesday afternoon sessions will eventually disappear. A two-hour Wednesday afternoon type of schedule could be an effective practice if the professional development were part of a continuous, ongoing growth plan for that individual teacher. Simply having a speaker stop by the school on Wednesday afternoon to address a topic such as classroom management is not valuable. Teachers must be educated about professional development. The time spent on these activities is “their time” to grow professionally, not just a time to grade papers. Saying a school is providing professional development and actually experiencing true professional development are very different. The PREPS organization could make a big impact if an overview of effective professional development was added to the services that they already provide member districts.

Further research is needed in the area of the effectiveness of the PREPS Biology I workshop series in impacting student achievement. Exploring the “Nature of Science” assessment strand results provided some very interesting information. However, further research would have to be conducted to contribute any student success to the workshop materials. Observations of the teachers actually teaching the experimental design unit is recommended along with student reactions and successes over a longer period of time.
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Mississippi Department of Education. (2003c). Mississippi subject area testing program (SATP). Jackson, MS: Author.


PREPS, Inc.: Center for Educational Partnerships. (1999). *Subject area final report.* Mississippi State University, MS: Bridges.


Location of sessions:

Subject Area: BIOLOGY I

Presenter:

Your total years of teaching experience: teaching in this subject area:

Please rate the logistics of the series with 5 being the highest and 1 being the lowest.

Facilities: 1 2 3 4 5

Scheduling: (two day initial session, 2 day follow-up session, 1 day follow-up session, all spread over several months)

1 2 3 4 5

Please rate this series on the following scale:
5= outstanding and/ or very valuable
4= excellent and/ or valuable
3= helpful but not very important
2= not very good and seemingly unrelated
1= poor and/ or irrelevant

a. Quality of presentations
   content 1 2 3 4 5
   delivery 1 2 3 4 5

b. Discussion and interaction
   with presenter 1 2 3 4 5

c. Small group work 1 2 3 4 5

d. Units and other handouts 1 2 3 4 5

e. Overall effectiveness 1 2 3 4 5

Comments:

What was the most effective part of the series for you?
What suggestions would you make if the sessions were to be presented again?

Would you be interested in one or more follow-up sessions next year? If so, what would you like to see included in the session content?

Please indicate which strategies from the Subject Area Workshop sessions that you have tried in your classroom. (Check any strategy that you used.)

- [ ] using reading for information strategies when answering questions
- [ ] having students construct graphs for classwork/experiments
- [ ] having students read and interpret graphs
- [ ] having students design and carry out their own experiments
- [ ] having students use simple tools in lab situations
- [ ] having students write a lab report
- [ ] having students present work orally to the class
- [ ] having students make models to reinforce concepts
- [ ] having students use learning style cards
- [ ] having students use role play to understand concepts
- [ ] used selected response items on classroom assessments
- [ ] used constructed response items on classroom assessments
- [ ] used more diagrams and pictures on tests
- [ ] used conferences to help students improve work
- [ ] other (please specify)

Choose one of the above strategies that you checked and describe your implementation of it and how it impacted your classroom.
APPENDIX B

QUESTIONNAIRE
### Biology I Questionnaire

#### Part 1

A. Please circle the number which most closely indicates the degree to which the content of the PREPS Biology I workshop affected your knowledge about each indicator.

Use the following scale: 3, to a great extent; 2, to some extent; 1, little or no extent.

The PREPS Biology I workshop has improved my knowledge about the following

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Great extent</th>
<th>Some extent</th>
<th>Little or no extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student reading for information&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student constructing graphs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student interpreting graphs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student designing their own experiments&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student picking out experimental variables and controls from scenarios&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student making models to reinforce concepts&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student use of learning cycle cards&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student use of role-play&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student answering open response items&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing open response items&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Grading student work using a rubric&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using Biology I review guide for test preparation&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using professional reading to update practices&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

*<sup>a</sup>= Experimental Design Unit;  <sup>b</sup>= Cell Division Unit;  <sup>c</sup>= Assessment Practices;  <sup>d</sup>= On-going Teacher Improvement Practices
B. Please circle the number which most closely indicates the degree to which the content of the PREPS Biology I workshop affected your skill in using each indicator.

Use the following scale: 3, to a great extent; 2, to some extent; 1, little or no extent.

<table>
<thead>
<tr>
<th>The PREPS Biology I workshop improved my skill in the following areas</th>
<th>Great extent</th>
<th>Some extent</th>
<th>Little or no extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student reading for information( ^a )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student constructing graphs( ^a )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student interpreting graphs( ^a )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student designing their own experiments( ^a )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student picking out experimental variables and controls from scenerios( ^a )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student making models to reinforce concepts( ^b )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student use of learning cycle cards( ^b )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student use of role-play( ^b )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student answering open response items( ^c )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items( ^c )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing open response items( ^c )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Grading student work using a rubric( ^c )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using Biology I review guide for test preparation( ^c )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using professional reading to update practices( ^d )</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

\( ^a \) = Experimental Design Unit; \( ^b \) = Cell Division Unit; \( ^c \) = Assessment Practices; \( ^d \) = On-going Teacher Improvement Practices
### Part II

Using the following scale, please circle the number that indicates the degree to which you have implemented the following practices.

- **5** use as a regular part of classroom practice when appropriate
- **4** use often
- **3** use infrequently
- **2** tried but have discontinued use
- **1** have never used

<table>
<thead>
<tr>
<th>Practice</th>
<th>Regular</th>
<th>Often</th>
<th>Infrequently</th>
<th>Discontinued</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having students read for information</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students construct graphs</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students interpret graphs</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students design experiments</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students pick our experimental and control variables</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students make models to reinforce concepts</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students use role-play</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Having students answer open response items</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing enhanced multiple-choice items</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing open response items</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Grading student work using a rubric</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using Biology I Review guide for test preparation</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Using professional reading to update knowledge</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Constructing another teaching unit using material from this workshop series</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Open-ended questions:**

1. Choose at least one (1) strategy from this workshop series that you enjoy using. Describe your implementation of it and how it impacted your students.

2. Have you taken any of the workshop strategies and implemented them into another lesson or unit of study? Briefly describe how you have used information from the workshop in other areas.
Part III

The following statements refer to organizational structures or policies of your school and personal qualities of your teaching. Please circle the number that indicates the degree to which you agree of disagree with each statement.

Use the following scale: 5, strongly agree; 4, agree; 3, neither agree nor disagree; 2, disagree; 1, strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>The content of the Biology I workshops is aligned with our school mission,</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>goals, and objectives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The organizational structure of our school (length of class time,</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>scheduling of classes, curriculum offerings, etc.) is conducive to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>teaching, using strategies which were modeled in the Biology I workshops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The administration, faculty, and staff of our school work together to</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>improve student learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An atmosphere exists in our school that permits/encourages educators to</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>try new instructional practices without fear of criticism.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A norm of continuous improvements exists in our school that recognizes</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>that learning about best practices in our profession is never finished.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have ready access to expertise when implementation problems or</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>difficulties in instruction are encountered.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The resources required to implement new practices are available in my</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>school.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have sufficient time to plan for instruction.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I have time and opportunity to collaborate with my colleagues.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Teachers in my school are recognized and rewarded for their successes</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>with students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have a high level of confidence in my ability to teach the content of</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>my Biology I classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I readily try new teaching strategies which I think may benefit my</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>classroom practice.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part IV

Please indicate the degree to which you agree or disagree with each statement by circling the corresponding number. Use the following scale: 5, strongly agree; 4, agree; 3, neither agree nor disagree; 2, disagree; 1, strongly disagree.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The content of the PREPS Biology I workshop has positively impacted my students' classroom performance.

The content of the PREPS Biology I workshops has positively impacted my students' performance on the Biology I Subject Area Test.

Please feel free to place additional information and comments on the back of this sheet. Please return in the stamped, self-addressed envelope! Thanks for your valuable time!

NOTE: The original questionnaire that was mailed to participants was placed on three pages. However, the margins on the original questionnaire would not conform to this paper’s format. This questionnaire has been separated due to margin limitations.
APPENDIX C

PROFESSIONAL VITA

JACQUELYN SCIPPER SAMPSELL
Jacquelyn Scipper Sampsell

Education
Presently student in Ed.D program, Curriculum and Instruction, Mississippi State University
1990 received a MS degree in Secondary Education, Mississippi State University
1978 received a BS degree in Secondary Education, Biology, Mississippi State University
1974- 1976 attended Mississippi University for Women

Employment History
Presently Assessment Development Manager, Harcourt Assessment, Inc., San Antonio, TX
1995- 2001 Biological science teacher, Philadelphia High School, Philadelphia, MS
1984-1995 Biological science teacher, Neshoba Central High School, Philadelphia, MS
1978-1982 AP and General Chemistry teacher, Briarcrest High School, Memphis, TN

Professional Accomplishments and Affiliations
2001 awarded Distinguished Science Teacher, Mississippi Science Teachers Association
2000 selected Philadelphia High School STAR teacher
1999 recipient of Milken National Educator Award, Mississippi
1999 featured in Success Mississippi Style, Mississippi Department of Education
1997 recipient of Wal-Mart Teacher of the Year, Philadelphia, MS
1997 selected Mississippi 3rd Congressional Teacher of the Year, Philadelphia School District Teacher of the Year
1996 awarded Mississippi Outstanding Biology Teacher, National Association of Biology Teachers
1995 awarded Sigma Xi Outstanding High School Teacher, Mississippi State University
1995-present member of Delta Kappa Gamma, Xi Chapter, 2nd Vice President, Treasurer
1994 awarded Outstanding High School Teacher, Mississippi Science Teachers Association
1994 selected Neshoba County School District Teacher of the Year
1994 awarded Phi Delta Kappa Excellence in Education, Mississippi State University
1993- present member of Mississippi Association of Biology Educators, past President
1989- present member of Mississippi Science Teachers Association
1989- present member of National Association of Biology Teachers
1989- present member of National Science Teachers Association

Publications and Presentations
2004 presented at ASCD National Conference, New Orleans, LA
2003-2005 presented at PREPS Winter Conference, Jackson, MS
2000 presented at Milken Educational Foundation National Conference, Los Angeles, CA; Mississippi’s Milken Educational Foundation Conference, Jackson, MS
1997-2000 editor of MSABE Newsbytes, newsletter of Mississippi Biology Educators
1996 co-authored Mississippi Biology Teacher Resource Guide: Cell and Molecular Edition
1992-2000 presented at Mississippi Science Teachers Conventions, Jackson, MS
APPENDIX D

PARTICIPANTS’ RATINGS OF PREPS BIOLOGY I

WORKSHOP ON THE FINAL EVALUATION FORM
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facilities</td>
<td>4.72</td>
</tr>
<tr>
<td>Scheduling</td>
<td>4.66</td>
</tr>
<tr>
<td>Quality of presentations: content</td>
<td>4.84</td>
</tr>
<tr>
<td>Quality of presentations: delivery</td>
<td>4.82</td>
</tr>
<tr>
<td>Discussion and interaction with presenter</td>
<td>4.91</td>
</tr>
<tr>
<td>Small group work</td>
<td>4.81</td>
</tr>
<tr>
<td>Units and other handouts</td>
<td>4.96</td>
</tr>
<tr>
<td>Overall effectiveness</td>
<td>4.89</td>
</tr>
</tbody>
</table>

Note: Participants used a 5 point rating scale delineated as follows: 5=outstanding and/or very valuable, 4=excellent and/or valuable, 3=helpful but not very important, 2=not very good and seemingly unrelated, 1=poor and/or irrelevant
TABLE 10. Participants’ Ratings of PREPS Biology I Workshop on the PREPS Final Evaluation Form – Specific Strategies

<table>
<thead>
<tr>
<th>Strategy Used in Classroom</th>
<th>Percentage (%) of Teachers that Tried the Strategy in Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using reading for information</td>
<td>74%</td>
</tr>
<tr>
<td>Having students construct graphs</td>
<td>96%</td>
</tr>
<tr>
<td>Having students read and interpret graphs</td>
<td>98%</td>
</tr>
<tr>
<td>Having students design and carry out experiments</td>
<td>77%</td>
</tr>
<tr>
<td>Having students use simple tools in lab situations</td>
<td>96%</td>
</tr>
<tr>
<td>Having students write a lab report</td>
<td>66%</td>
</tr>
<tr>
<td>Having students present work orally to the class</td>
<td>69%</td>
</tr>
<tr>
<td>Having students make models to reinforce concepts</td>
<td>81%</td>
</tr>
<tr>
<td>Having students use learning cycle cards</td>
<td>40%</td>
</tr>
<tr>
<td>Having students use role play</td>
<td>40%</td>
</tr>
<tr>
<td>Used selected response items on classroom assessments</td>
<td>92%</td>
</tr>
<tr>
<td>Used constructed response items on classroom assessments</td>
<td>87%</td>
</tr>
<tr>
<td>Used more diagrams and pictures on tests</td>
<td>79%</td>
</tr>
<tr>
<td>Used conferences to help students improve work</td>
<td>43%</td>
</tr>
</tbody>
</table>