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A comparison study on teacher-centered and inquiry-based instruction in science education of middle school students with learning disabilities: what is effective?

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A COMPARISON STUDY ON TEACHER-CENTERED AND INQUIRY-BASED INSTRUCTION IN SCIENCE EDUCATION OF MIDDLE SCHOOL STUDENTS WITH LEARNING DISABILITIES: WHAT IS EFFECTIVE?

by

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Dedication

I would like to dedicate this manuscript to my husband Tom, my parents James and Penelope Yorke for their continued support, to my three children Tristan, Caleb, and Nolan, and to my friends and family who have helped make this dream a reality

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Abstract

Jessica S. Yorke-Servis

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5/10/2012

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Master of Arts in Special Education

The purposes of the study are to examine the effects of inquiry-based and teacher-centered instruction methods when teaching science for middle school students with learning disabilities. These two instructional methods were provided to 81 students in two middle schools located in southern New Jersey. Of those, 30 students with learning disabilities, 15 in each school participated in the study. Both groups were given a pre and post test prior to and after the three weeks of science instruction to evaluate student performance. In addition, a student and teacher survey was provided to examine their satisfaction. The results show that students with learning disabilities receiving teacher-centered instruction gained 11% higher on the posttest than those taught by inquiry-based instruction. However, students receiving inquiry-based instruction reported that they enjoyed their learning and would have a career in science.

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CHAPTER I

Introduction

Statement of the Problems

Science is an important subject area in school in the 21st century. Science education focuses on the practices of science that lead to a greater understanding of the growing body of scientific knowledge that is required of students in an ever-changing world. It builds foundation for knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

A recent study by the U.S. Department of Commerce shows that over the past 10 years, the growth of jobs in Science, Technology, Engineering and Mathematics (STEM) was three times greater than that of non-STEM. The report also shows that STEM jobs are expected to continue to grow at a faster rate than others in the coming decade. "There is a clear benefit to providing our students with the strong science education needed to compete in college and the workplace," said Dr. Stephen Pruitt, Vice President of Content, Research and Development at Achieve. He also said that a strong science education provides all students with opportunities to be successful in the 21st century. Unfortunately, American students lag behind internationally in learning science, making them less competitive for present and future jobs according to a report published by the National Commission on Excellence Education (1983). Student performance in eighth-grade science was lower than those in other countries such as China, Taipei, the Czech Republic, England, Hungary, Japan, the Republic of Korea, the Russian Federation, Slovenia, and Singapore (TIMSS, 2007). Thus, a reform in science education is called to begin as an initiative to increase student performance in learning science.

In 1985, the American Association for the Advancement of Science initiated Project 2061: Science for all Americans. The goal of the initiative is to develop a scientifically literate society by the year 2061 for all American students. To achieve this goal, Project 2061 conducts research and develops tools and services that educators, researchers, and policymakers can use to make critical and lasting improvements in the nation's science education. The American Association for the Advancement of Science created *Benchmarks for Science Literacy*, to establish standards for learning science, mathematics, and technology by the end of grades 2, 5, 8, and 12. Subsequently, when The National Research Council (NRC) published the National Science Education Standards (NSES) (1996) focusing on "science for all students... regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science." (p. 2). Although the standards in science education targeted "all students," there were limited discussions on its implementation related to students with disabilities. It is not until the law of No Child Left Behind (NCLB) enacted in 2002, requiring the assessment of all students in science, including those with disabilities.

According to the Individuals with Disabilities Education Act (IDEA) in 2004, students with disabilities must be taught in the least restrictive environment (LRE). This means that a student who has a disability should have the opportunity to be educated with non-disabled peers, to the greatest extent appropriate. They should have access to the general education curriculum, or any other program that non-disabled peers would be able to access. The student should be provided with supplementary assistance and services necessary to achieve educational goals if placed in a setting with non-disabled peers. LRE has lead to a change in the science classroom to become an inclusion setting where students with and without disabilities are placed together. Because of the diverse student population in an inclusive learning environment with students

with disabilities and their non-disabled peers, science teachers are challenged to meet the needs of all learners at many different levels, especially individuals with special needs.

Of the students with special needs, many are classified as having learning disabilities. Learning disabilities are identified in childhood persisting throughout life. It is a neurological disorder causing difficulty in organizing, remembering, expressing information, and affecting a learner's basic function such as reading, writing, comprehension, and reasoning. Students with learning disabilities tend to lack organizational skills and learning strategies. According to the Learning Disabilities Association of America (2011) approximately 4 to 6 percent of all students are classified as having specific learning disabilities (SLD) in our nation's public schools. Many times these students are pulled out from a science class in elementary school for remedial instruction in the basic skills areas such as reading and math. As a result, they miss foundational science knowledge and skills, and have difficulty in learning science.

The National Science Education Standards (2011) identify the teaching levels as K–4, 5–8, and 9–12. The middle grades (5-8) are considered significant for helping students meet science goals because of the importance of the new information, new approaches to teaching science in laboratories, and the new focus on science as a discipline instead of a collection of disciplines (often unrelated and at times in conflict). Middle schools often do not employ one teacher for all disciplines as commonly found in elementary schools; nor confine the disciplines to biology, earth science, chemistry, and physics as commonly found in high schools. Different instructional strategies are used throughout middle school science classrooms, for example, traditional approach and inquiry-based instruction. Traditional teacher-centered instruction can be described as a teacher directly controlling instruction. This approach focuses on lectures, discussions, questioning, and demonstrations. The inquiry-based instruction is described as a set of

interrelated processes, by which teachers and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories (NRC, 1996). It requires more than hands-on activities, but to follow problem solving processes that can be applicable to the real world. It is found that inquiry-based approach in science instruction has a positive impact on student performance such as achievement scores, process and analysis skills, logical thinking and improvement in reading and math (Shymansky, Kyle & Alport, 1983). It is also found that students with learning disabilities could improve their performance in learning science when taught with an inquiry method as compared to traditional textbook approach (Scruggs, Mastropieri, Bakken & Brigham, 1993).

In contrast, there are some limitations in the use of an inquiry approach. The first is that many teachers do not have training. Even science teachers within general education have expressed a lack of preparation for inquiry-based instruction (Luft, Bang, Roehrig, 2007). Second, some experts question the premise of minimal guidance during the instruction. Learners may need guidance until they have sufficiently high prior knowledge to self-direct their learning (Minner, Levy, & Century 210). Students with learning disabilities need "something more" to guide their learning during inquiry-based instruction (Scruggs & Mastropieri, 1995).

The American Association for the Advancement of Science (AAAS) (1993) and NRC (1996) endorse science curricula that actively engage students in learning science using an inquiry-based approach. This approach has shifted the focus of science education from the traditional memorization of facts and concepts in separate specific disciplines to inquiry-based learning in which students seek answers to their own questions. The pedagogy advocated for discovery learning and high levels of thinking, in which students are actively engaged using both

scientific processes and critical thinking skills as they search for answers. It has been found that inquiry-based instruction activities had positive effects on student achievement, cognitive development, laboratory skills, scientific process skills, and understanding of knowledge as a whole when compared to students taught using a traditional approach (e.g. Chang & Mao,1998; Ertepinar & Geban, 1996; Geban, Askar, & Ozkan, 1992; Mattheis & Nakayama,1988; Padilla, Okey, & Garrand, 1984; Purser & Renner, 1983; Saunders & Shepardson,1987; Schneider & Renner, 1980; Wollman & Lawson, 1978). It seems that inquiry-based instruction is an effective method for students to learn science, and using an inquiry approach would promote student learning (Gibson & Chase, 2002).

According to Mastropieri and Scruggs (1994), inquiry-based instruction, an activities-oriented approach reduces the reliance on textbooks, lectures, knowledge of vocabulary, and pencil-and-paper tests to benefit students with learning disabilities. This approach seeks to promote learning by providing students with experiences that allow them to discover and experiment with science. Through discovery and inquiry, teachers involve students in creating and expanding their knowledge and understanding about the content area being studied (Mastropieri & Scruggs, 1995). There are many studies conducted in middle school and high school to evaluate inquiry-based instruction in science. However, there is limited research in teaching students with learning disabilities. This study will use both traditional and inquiry-based instructional methods to teach science in the eighth grade to students with learning disabilities. It attempts to compare the difference on student performance in learning science, and add information to science education.

Significance of the Study

Students with learning disabilities (LD) tend to lack content knowledge in science due to previous pull-out remediation as well as struggle with reading, writing, and computation combined with having a poor self concept as a learner. Motivating these students in learning science and accommodating their specific academic needs are challenging to science teachers. How can a teacher create a challenging and exciting learning environment in an inclusive classroom for all students? How can science teachers fill the content gaps of individuals with learning disabilities, while continuing to challenge all learners in the classroom? How can science teachers overcome these obstacles, but motivate students to master the concepts and teach problem solving skills? What is the appropriate instructional method to teach science to students with learning disabilities? These questions need to be explored. In this study, inquiry-based instruction is used in teaching science to middle school students. It is designed to examine the effect of such an instructional strategy for individuals with learning disabilities. It attempts to add valuable information to the field of science education specifically the instruction of students with learning disabilities.

Statement of Purposes

The purposes of this paper are to: (a) examine the effect of inquiry-based instruction in teaching science for middle school students with learning disabilities. (b) to compare the difference of student performance in two teaching conditions: traditional instruction vs. inquiry-based instruction. (c) compare the difference of student satisfaction in learning science with inquiry-based instruction to traditional instruction.

Research Questions

1. Will students with learning disabilities gain scores on their unit tests in learning science when the inquiry-based instruction is provided?
2. What are the perceptions of students with learning disabilities on learning science when inquiry-based instruction is provided?
3. What is the difference between student performances when inquiry-based instruction is provided compared to that of teacher centered instruction?

CHAPTER II

Review of the Literature

Since the inception of NCLB in 2002, all students are required to participate in their statewide assessment. This assessment evaluates all student achievements in reading, math, and science, including those with disabilities. Science is a required subject area in achievement tests and all students are required to meet the state mandatory standards in science education. Currently there are two prominent teaching strategies in science education: teacher-centered and inquiry-based instruction. This chapter reviews these instructional strategies and discusses how each strategy relates to effectively teaching science to students with learning disabilities (LD).

Students with LD in Learning Science

One of the four guiding principles of the National Science Education Standards is simply "science for all students" (NRC 1996). This principle underscores the belief that all students, regardless of race, gender, or disability, should have the opportunity to learn and understand the essential science content described in the standards. Because of increasingly widespread inclusion practices and more thorough identification procedures, students with LD are becoming a large group in the science classroom. Between 5% and 10% of all K-12 students are identified as having a specific learning disability (Department of Education, 2002) and it is anticipated that this number will grow (Kavale & Forness, 1995). Individuals with LD generally have average or above average intelligence, yet they often do not achieve at the same academic level as their peers. Their weak academic achievement, particularly in reading, writing, and math, is perhaps the most fundamental problem.

Students with LD often struggle with academic subjects in their general school curriculum and their science classes. Between 36% and 56% of students with LD leave high school without a diploma or certificate of completion and their average scores of science achievement tests are almost one standard deviation below than that of those without disabilities (Anderman, 1998). These students experience difficulty in many skills and lack the appropriate strategies needed to become successful in a science setting (Bucalos & Lingo, 2005). According to Alden and Grumbine (2006), these students exhibit deficits in organization, reading, memory and writing. They benefit from appropriate instructional methods to meet their needs and enhance learning opportunities.

Although the growing importance of science education for students with LD has been recognized, research by Patton, Polloway, and Cronin (cited in Cawley, 1994) indicated that many of the students receive very little or no science instruction. This can be explained by students being pulled out to be remediated for basic skills during the time period for science. Further, many practicing science teachers have little training or few experiences in identifying and meeting the needs of students with disabilities (Stefanich & Egelston, 1995). They are not adequately prepared to teach these students and often use a content-oriented approach that focuses on learning vocabulary words and factual information through textbooks and teacher-directed presentations, such as lectures and teacher's demonstrations (Mastropieri & Scruggs, 1994; Weiss, 1993).

According to Salend (2005), students with LD face many challenges in learning science. These include their impairments in one or more of the following areas: comprehension, spelling, articulation, written expression, problem solving, and/or math computation; all of which are applicable to learning science (Martinez 2006). Content specific vocabulary, complex scientific

text in learning materials, note taking, listening, and writing are just a few basic skills that these students are challenged with (Alden & Grumbine, 2006). Therefore, they often receive low grades and perform significantly behind their general education peers (Holahan, McFarland, & Piccillo, 1994; Parmar & Cawley, 1993). Definitely, these students can learn science and master skills when teachers employ instructional adaptations based on research approved effective practices (Grossen & Carnine, 1996; Scruggs & Mastropieri, 1993).

Strategies in Science Instruction

Science teachers are challenged daily to modify instructional materials and strategies to meet the needs of all learners, including those with LD. To achieve equal access to the general education science curriculum, students with LD must be able to engage in class and process the information presented in a meaningful way. Therefore, teachers must be prepared to present materials through effective research-based instructional methods (Teaching Science to Students, 2003). There are two commonly used instructional strategies in teaching science. One is traditional teacher-centered instruction and another is student-centered instruction, known as inquiry-based instruction.

Traditional Instruction. Traditionally, Teacher-Centered Instruction is described as teacher lecturing and textbook oriented instruction (Tekkaya, 2006). The two main characteristics of the instruction are lecture oriented and text book based. In the teacher-centered instructional model, teachers select a topic or skill for the lesson, then, students practice independently following the teacher's guidance. There is limited interaction between students and the teacher and among the students. This instructional method is typically provided in science instruction.

The strength of teacher-centered instruction is its explicit procedures through whole class lecture that would be appropriate for teaching facts, concepts, vocabulary, and theories. Students are guided with a step by step fashion in the learning process. The instructional procedures are incremental, sequential, and highly organized, allowing students with LD to follow steps to complete complex tasks (Tanner, 2003).

Three levels of practice are commonly applied in teacher-centered science instruction. The first level consists of reading about products and processes of science or being told. The second level is class discussion among students or between students and the teacher. The third level is the teacher's demonstration of an experiment followed by lecturing with explanations (Renner & Staford 1970).

Textbooks are the major resource in class (Woodward, 1992). Science textbooks today include a tremendous amount of information along with grade appropriate vocabulary words. Science curriculum is based upon textbooks to provide the methods of teaching. There is a close relationship between the text, the course of study, and the systematic instruction according to the topics of the text. If students come from underprivileged homes, textbooks are the main resource for information in learning science. As a conclusion, it is found that when teaching explicit procedures and comprehension, repeated practice is provided for students with LD resulting in increased test scores (Burton 2006).

This was evidenced in McCleery & Tindal's study (1999) in which a significant difference in student performance was found when teacher-centered instruction was provided comparing with inquiry-based instruction. The study was conducted in an urban school district located in the Pacific Northwest. A total of 57 sixth-graders in two general education science classes participated. Of these, 14 are classified as having learning disabilities, and receiving

special education services. A 90-minute block time was scheduled every other day, for a science class taught by the general education teacher using the textbook of Physical Science (Cooney, Pasachoff, & Pasachoff, 1990).

The goal of this study was to assess the effect on student explanations of a scientific problem when they were taught from a teacher-centered conceptual basis using explicit, rule-based instruction. Results showed that in teacher-centered instruction, 78% of students included an explanation, and in inquiry-based, 36% of the students included an explanation. A significant difference between the teacher-centered instruction and inquiry-based instruction was found. The study shows clear, direct, rule based instruction is more effective for students with LD than inquiry-based instruction. It seems that using explicit, step by step instruction focused on a text-book and guided by a teacher benefits these students. The problem is that students with LD have difficulty detecting important information in a book with rich texts (Woodward 1994). Textbook publishers often neglect certain skills the students need to further develop.

Meanwhile, students with LD do not always acquire skills in the normal developmental sequence (Reading Methods and Learning, 1990). If adequate phonemic awareness is not developed by a student with LD during the pre-reading period, effective decoding may not be possible (Reading Methods and Learning). For example, phonemic awareness influences the development of fluent reading and comprehension skills. This is why these students have difficulties in reading the science textbook that teacher-centered instruction is based on.

Inquiry-based Instruction. The Inquiry-based instructional approach refers to a process where students explore, investigate, search for information, and discover and seek solutions to the problem issue under a teacher's guidance (Otieno, 1999). The American Association for the Advancement of Science (AAAS) (1993) and the National Research Council (NRC) (1996)

endorse science curricula that actively engage students in science using an inquiry-based approach. This approach has shifted the focus of science education from the traditional memorization of facts and concepts in separate specific disciplines to inquiry-based learning in which students seek answers to their own questions. The pedagogy advocated for is an inquiry approach, in which students are actively engaged using both science processes and critical thinking skills as they search for answers. This inquiry engages students in using multiple tasks such as mathematics, reading, and writing as they gather and analyze data in regards to the guiding question or problem (Collins et. Al., 2001).

The Inquiry-based instructional method requires teachers to plan in advance to allow the classroom atmosphere to be conducive to inquire. Before students begin their investigation, a strong foundation of basic scientific concepts must be laid out to support their inquiry. This foundation includes creating an environment to enable students to become comfortable for offering and sharing their thoughts and opinions (Beaver et. Al., 2003). Therefore, it is imperative to create a foundation based on inquiry skills. The first step in this process is that the teacher must create a question which catches student attention and interest. The second step is that teachers must guide students towards the objective of the lesson(s). In addition, teachers must exhibit improvisational skills due to the multiple directions this method could explore. Thus, teachers should be cognizant of the questions they ask and be flexible serving as a resource person (Beaver et. Al., 2003). An inquiry requires the ability for students to pursue questions, evaluate solutions, and gather information to seek out answers (Beaver et. Al., 2003).

Many studies found inquiry-based science instruction for middle and high school students had positive effects on students' science achievement, cognitive development, laboratory skills, science process skills, and understanding of science knowledge as a whole when compared to

students taught using a traditional approach (Chang & Mao, 1998; Ertepinar & Geban, 1996; Geban, Askar, & Ozkan, 1992; Mattheis & Nakayama,1988; Padilla, Okey, & Garrand, 1984; Purser & Renner, 1983; Saunders & Shepardson, 1987; Schneider & Renner, 1980; Wollman & Lawson, 1978).

Most research on middle and high school inquiry-based science programs examined students' achievement test scores or process skills as their comparison measures. However, the long-term impact on students' attitudes towards science and interest in science careers has not been explored. For example, Chang and Mao (1998) compared the impact of two weeks of traditional lecture-type instruction to two weeks of inquiry-based instruction on secondary students' achievement in learning earth science. It is found that students who were taught using the inquiry-based method scored significantly higher on an achievement test than those who were taught using the traditional lecturing approach.

It seems that scientific inquiry engages students in using the multiple literacies of mathematics, reading, writing, and oracy as they gather data, determine how these data constitute evidence for the claims they are generating, and share and evaluate these evidence-based claims with others. At the same time, students encounter significant conceptual challenges as they work toward an explanation of the phenomenon they are investigating (Palincsar 2001.)

Major findings indicated that middle school students experiencing the inquiry-based format with constructivist teaching practices: (1) learned basic concepts as well as students who studied them directly from the textbook, (2) achieved as much general concept mastery as students who studied in a textbook dominated way, (3) applied science concepts in new situations better than students who studied science in a more traditional way, (4) developed more positive attitudes about science, (5) exhibited creativity skills that were more individual and

occurred more often, and (6) learned and used science at home and in the community more than students in the typical textbook dominated section.

In a study by McCarthy, (2004) 18 middle school students with disabilities were taught, over the course of 8 weeks, on ‘‘Matter’’ by two different instructional approaches. Students in one classroom received a traditional textbook approach to science content, whereas students in another classroom received science instruction by a hands-on and thematic approach. Over the course of instruction, data were collected regarding students’ behavior and achievement. Results indicate that, overall, students in the hands-on instructional program performed significantly better than the students in the textbook program on science achievement, a hands-on assessment and a short-answer test.

Further, Yager and Akcay (2008) investigated inquiry-based instruction comparing a typical textbook dominated traditional teacher-centered approach in middle school science classrooms. The purpose of this study was to determine whether inquiry- based instruction increases student concept mastery, general science achievement, use of concepts in new situations, and attitudes toward science. Two teachers and 52 students in grades six through eight participated in the study. Two sections of middle school science were taught by two teachers where one used an inquiry-based approach and the other retained a typical use of the textbook as a class organizer. Each teacher administered the same pre- and post-assessments. It seems evident that concept mastery is not lost when students explore and act on their own as part of class projects. Most important, students learning inquiry-based methods can apply the science concepts that they seem to know in new situations. This is impressive evidence that inquiry-based instruction makes learners really comprehend; they can use the information and skills on their own in new situations. The development of more positive attitudes suggests that benefits in

the affective domain may result which in turn provide strong arguments about the desirability of organizing lessons around ideas and procedures other than basic science concepts and processes, especially in middle schools. As Hodson (1990) indicated, inquiry-based learning is a more effective way for students to learn science. Additionally, students who use an inquiry approach have improved attitudes towards both science and school while other studies show more negative attitudes resulting from traditional methods (Gibson, 1998a, 1998b; Jaus, 1977; Selim & Shrigley, 1983; Shrigley, 1990).

It appears that inquiry-based instruction is more effective for students with LD. Research shows that these students tend to gain scores on their unit tests in learning science when the inquiry-based instruction is provided. However, students with LD did not demonstrate the same conceptual growth as their non-disabled peers (Collins et. Al., 2000). It is found that these students have difficulty participating in the inquiry activities, because they lack essential factual and conceptual knowledge. They need considerable instruction and encouragement to be successful in this learning process. Teachers must feel comfortable enough with the content in order to assist students in their exploration through self-questioning. If the material is not mastered, or students are not up to the challenge, inquiry-based instruction will be difficult for teachers to implement and prepare for, and in turn these students may not benefit when such an instructional approach is provided.

Summary

The IDEA Amendments of 1997 require that students with disabilities have access to the general education curriculum. This legislative requirement makes the accessibility of curricular materials an issue of even greater importance than it otherwise would be. To meet the goal of

equal access to the curriculum for everyone, to enable each student to engage with his or her lessons in a meaningful way, teachers must be prepared to provide useful alternatives in terms of both curriculum materials and instructional delivery. Well-adapted materials without an effective method of teaching are practically useless, but with the proper tools and instructional methods, a good teacher can encourage each member of the class to participate directly in the learning experience.

Learning science is a challenge for students with LD because it requires synthesizing the skills of reading, writing, listening, and math. Students with LD have difficulty in these basic skill areas. It is a teacher's challenge to motivate these students in learning science and to provide an appropriate teaching strategy to benefit these students. Traditional teacher centered instruction is centered on texts, lectures, and note taking. Inquiry-based instruction allows students to be responsible in their own learning process through their own interests to formulate their own problems. In recent years, research was conducted to evaluate effective instructional methods in middle school science instruction (Liu, 2010). Further studies may need to be conducted to evaluate instructional methods in teaching science for students with learning disabilities.

CHAPTER III

Methodology

Setting

This study was conducted in two suburban middle schools in southern New Jersey. One school provided inquiry-based instruction in all science classes, and the other provided a traditional teacher-centered instruction model. Two teachers, one from each school, teaching middle school science in an inclusive setting participated in this study together with their students. The classroom in one school is a small, and another is split with one side for instruction and another for fixed laboratory tables. Students were in inclusion settings, including both regular students and those with learning disabilities (LD) classified by the school's child study team according to the state's administration code. All lessons were taught by a certified science teacher with a special education teacher as in class support in each school. In school 1, there are three classes assigned to provide inquiry-based instruction. In school 2, there are two classes assigned to provide teacher-centered instruction.

Participants

A total of 81, 7th and 8th grades in the two schools were permitted to participate in the study. The students range from ages of 12-16. Table 1 presents the information of participating students.

Table 1

Participating Students Information

Participating Schools	Students	Gender	Grade
School 1	49	26 Males 23 Females	7th
School 2	32	17 Males 15 Females	8th

Of the participants in the two schools, 36 students were classified as LD. Table 2 presents their information.

Table 2

Information of Participating Students with LD

Participating School	Students with LD	Gender
School 1	19	Males 12 Female 7
School 2	17	Males 12 Female 5

Of these students 53% are Caucasian, 25% are African American, 8% are Asian and 14% are Hispanic. Figure 1 presents the ethnic information.

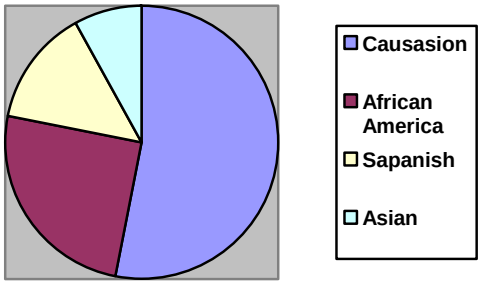

Figure 1. Percentage of Participating Students with LD in Ethnic Groups

Materials

Instructional Materials

The science lessons are both on one unit, cells were taught for three weeks.

Inquiry-based Instruction. School 1 is assigned to provide inquiry-based instruction. The curriculum consists of a scope and sequence guide for 7th and 8th grades including a textbook entitled Interactive Science, Organization and Development by Pearson with a student workbook and an online component. This textbook is complimented with daily activities from Measuring Up, and a test preparation guide. The scope and sequence guide is broken down into concept, standard, unit, lessons, objective, and number of days. A typical lesson includes a 10 minute warm up from Measuring Up, in the textbook to require students working quietly to solve the problems independently. The teacher then guides the students through highlighting key words to solve the warm up problems together with students by presenting the answers on a projector. The class is then guided through the lesson with their workbooks and notebooks. Students are constantly connecting with the text by filling in words, highlighting, or answering questions. The lab activities are completed weekly with a combination of online videos and experiments.

Teacher-centered Instruction. School 2 is assigned to provide teacher-centered instruction. Two science textbooks are used. These include: Cells, Heredity, and Classification Short Course C and Microorganisms, Fungi, and Plants Short Course A published by Holt Science and Technology. A typical lesson starts with 10 minutes for a warm up activity in which the students copy a science fact pertaining to the lesson from the smart board and then followed by teacher lecturing. The teacher also provides experiments as demonstrations. All the lab activities are teacher generated once a week following the textbook.

Measurement Materials

Tests. Pre and post tests were developed by the researcher and approved by both the regular education and special education teachers to assess student learning on cells and microorganisms. Each quiz consists of 30 questions in the format of multiple choices. (see Appendix A for an example). These tests were used prior to and after the three weeks of instruction.

Survey. *Student Survey*. A student survey was developed by the researcher based on Grabowskiet. al.'s study (2003). All survey questions were adopted from the survey in their study named "Science Teachers' Perspectives of Web-Enhances Problem-Based Learning Enviornment". The survey included 18 short questions regarding student satisfaction with learning science in class (see Appendix B).

Teacher Survey. A teacher survey was developed to examine teacher's perspectives in teacher-centered instruction or inquiry-based instruction in science education. It included 10 short questions in regards to planning time, student self management, and learning outcomes when teacher centered or inquiry-based instruction was provided.

Research Design

A pre and post test group design was used in the study. Within this research design students with learning disabilities are given a pre and a post test to measure their academic performance when inquiry-based instruction was provided comparing to teacher centered instruction. School 1 was instructed using inquiry based instruction and School 2 was instructed using teacher centered instruction. Both groups of students were instructed for three weeks. In addition, a self-report survey was administered to the teachers and students at the end of the study to examine their perspectives regarding their teaching and learning experiences.

Procedures

Instructional Procedures

Inquiry-based Instruction. A scope and sequence guide is used to depict lessons, objective and days for teaching specific concepts related to the state's Core Curriculum Standards. Each chapter includes three lessons. Within the Organization and Development unit in Life Science, there are two chapters and 6 lessons that pertain to cells and microorganisms. Teacher-centered Instruction. The instructional procedures followed the lesson plans designed by the text book publisher. The chapter covered three topics on cells: Diversity, Eukaryotic, and the Organization of Living Things. It also included a lab model on making elephant sized Amoebas. After all three topics were presented along with the lab demonstration the students completed the Chapter Review in the text book (see Table 4 for instructional procedures).

Table 3

Instructional Procedures

Inquiry-Based	**Teacher-Centered**
In this teaching method the teacher presented the students with the concept to be studied through active learning. Students are guided through active learning with structure and support for all activities. Student binders, notebooks, and workbooks are organized with tables of content, dates, and concepts. They are used and referred to throughout the year when learning new concepts, or reviewing previous concepts. They also provide background knowledge necessary for new concepts for all students to refer to.	In this teaching method, the teacher presented all information to students through lectures. The class completed the questions in the text book, the chapter review, and the labs included with the curriculum. The teacher modified the lab reports to accommodate all learners. They are scaffolded to begin with a lot of structure and throughout the year remove the supports to empower the student to complete them on his or her own.
Steps: 1. The warm-up was handed to students at the door and consisted of test prep question from Measuring up. 2. After approximately 7 minutes, the teacher guided the students through highlighting key vocabulary word and clues to solving the problem. 3. The students followed along highlighting their own papers and answering question aloud from the teacher. 4. Once finished, the students placed the warm-up in their science binders to reference at a later date. 5. The students were then given guided noted for the chapter with words missing and asked to fill in words, circle words, and highlight information throughout the lesson.	Steps: 1. The topic of cells and living things was introduced to the students. The teacher tried to activate students' prior knowledge by asking a series of oral questions. 2. The students were presented information on the topics in the textbook along with the 10 minute warm-up posted on the smartboard. The students are to copy the warm up in their science journals. The warm-ups go with the curriculum. 3. Steps one and two were repeated daily throughout the chapter. 4. The teacher lectures and the students are required to take notes. 5. The students answer chapter review question and the questions at the end of each lesson in their notebooks.

6. Once finished the students added the guided notes to their science binders. 7. The teacher then instructed the students to their workbooks to introduce a new topic. The text recalls information and asks students to think like a scientist. The students filled in brainstorming information and prior knowledge in the student text/workbook. 8. The text relies connects the science concepts to current industries and daily living. The videos are used in connection with the text and are accessible to the students from home.	6. The teacher goes over the question and answers aloud and the students check their answers.

Measurement Procedures

Testing. The pre and post tests were administered to two entire classes at School 1 and 2, but only the participating student's scores were recorded for the study. The tests were administered by the researcher with the regular education and special education teacher in the room. The pre and post tests were administered on paper and the students marked their answers on the scantron answer sheet by filling in the appropriate bubble that correlated to the testing questions. All students were required to complete their test in the classroom.

Survey. Two surveys were administered during this study, one for the students and another for the teachers. The student survey was administered in their class so that participating students would not be identified by their classmates. All students received a copy of the survey to review and complete individually in 30 minutes. The teacher survey was administered simultaneously to the regular and special education teachers in the classroom. The teachers read

and responded to the questions individually. Each teacher was given 30 minutes to complete the survey.

Data Analysis

Student pre and post test scores were analyzed statistically using an ANOVA analysis to examine the difference between two groups of students when teacher-centered or inquiry-based instruction was provided. In addition, student and teacher's survey responses were presented by frequency and percentages.

CHAPTER IV

Results

This study examined the effects of teacher-centered instruction and inquiry-based instruction for students with learning disabilities in learning science. A survey was also provided to participating teachers and students to investigate their satisfaction with their teaching and learning.

Student Achievement

Pre and post tests were administered to all participating students. Table 5 shows means, and standard deviations of test scores when teacher-centered instruction and inquiry-based instruction was provided. These scores are compared to that of students in School 2 using ANOVA to analyze the difference.

Table 4

Student Pre and Post Test Scores in Learning Science

Setting	Student Number	Pre Test		Post Test	
		Mean	SD	Mean	SD
School 1 Inquiry-based	15	38	3.85	43	4.96
School 2 Teacher-Centered	15	34	4.27	45	4.61

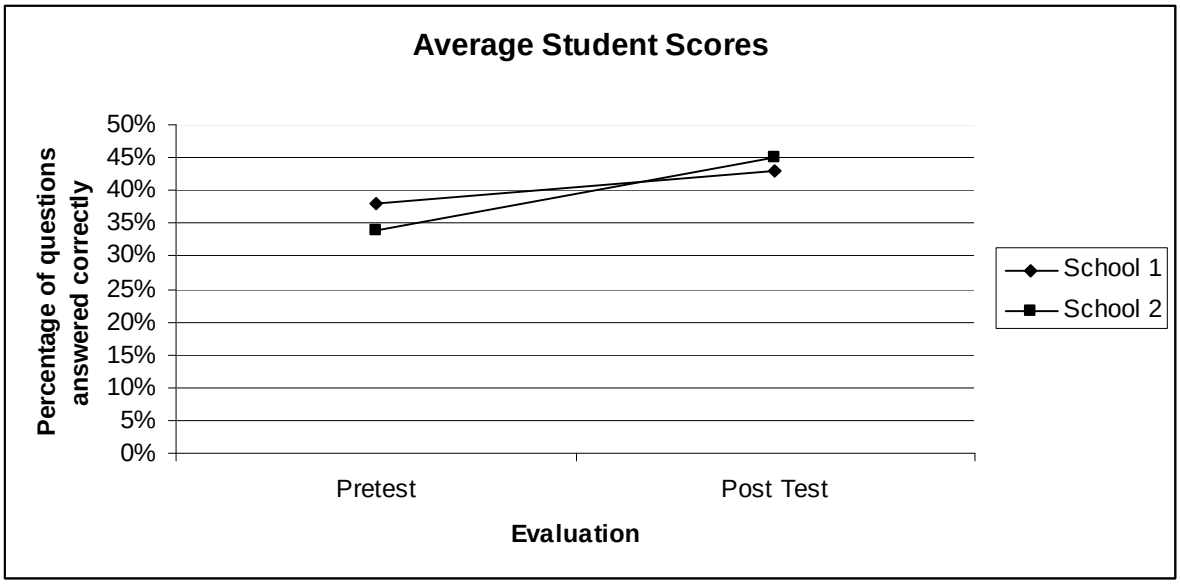

Figure 2. A Graph pf Pre and Post Test Scores

The pretest scores collected from both School 1 and School 2 were similar. There was a slight difference in average pretest scores between two schools, but not significant. The post test scores revealed an 11% increase when teacher-centered instruction was provided for students with learning disabilities, while only a 5% increase when inquiry-based instruction was provided. There is an interaction between the pre and posttest with a significance ($F = 4.39$, $p < .05$). Table 6 presents ANOVA Results.

Table 5

Results of the Analysis of Variance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	88.81667	1	88.81667	4.39842	0.0405
Interaction	16.01667	1	16.01667	0.793185	0.376949
Within Cells	1130.8	56	20.19286		

These results show there is an interaction between the pre and posttest and a significant difference between groups ($F = 4.39$, $p < .05$), in favor of School 2 when teacher-centered instruction was provided.

Student Survey

Table 6 presents the students' responses to the survey when they were taught using inquiry-based instruction and teacher-centered instruction. The students that participated in the study and the student survey are students that have been diagnosed with a learning disability. All students in the class including both regular education and special education students took the survey. Only the results of those with LD who participated in the study survey results were recorded and tallied.

Table 6

Responses to the Student Survey

Survey Question	Strongly Agree		Agree		Disagree		Strongly Disagree	
	I	T	I	T	I	T	I	T
1. Science is my favorite class.	21%	0%	58%	50%	16%	14%	5%	36%
2. I enjoy science class.	47%	7%	53%	50%	0%	14%	0%	29%
3. My favorite part of science is doing labs.	42%	14%	53%	64%	5%	14%	0%	7%
4. I participate in science class activities and experiments.	58%	14%	32%	7%	11%	50%	0%	29%
5. I feel my science class moves at an appropriate pace to me.	0%	7%	84%	43%	11%	14%	5%	36%
6. I will use the information I learned in my science class in my life.	0%	0%	11%	29%	68%	29%	21%	43%
7. I typically receive a grade of A or B in science.	16%	14%	47%	36%	21%	29%	16%	21%
8. Science has value in my life.	79%	57%	16%	43%	5%	0%	0%	0%
9. I will have a career in a science field.	63%	14%	32%	36%	5%	29%	0%	21%
10. I like the way my science class was taught.	21%	21%	63%	43%	11%	7%	5%	29%

The survey results reveal that 95% of students taught using inquiry-based instruction reported they enjoy learning science. Only 53% of students instructed using teacher centered instruction reported they enjoy science. This is a significant discrepancy. 50% of students taught using teacher centered instruction felt they would not have a career in a science field compared to 95% of those taught students of inquiry-based instruction indicated that they would have a career in a science field. This survey reveals a 45% discrepancy between the groups and how students value science in their lives. 89% of students in the Inquiry group and 72% of students in

the teacher-centered group reported that they will not use the information taught in their science class in their lives.

Teacher Survey

At the end of the study the three participating teachers took a survey. Table 8 presents the survey results. The special education teacher in school 1 was out on medical leave and unable to take the survey. Of the three teachers two were regular education science teachers and one was a special education teacher.

Table 7

Responses to the Teacher Survey

Survey Question	Strongly Agree		Agree		Disagree		Strongly Disagree	
	I	T	I	T	I	T	I	T
1. I have had official training in Teacher Directed or Inquiry-Based instruction.	100%	50%				50%		
2. The students respond well to the teaching style used in my classroom.	100%			50%		50%		
3. I think my current instructional strategy is researched based.	100%	100%						
4. My students are actively engaged in 50-75% of the class time.	100%	50%		50%				
5. I think all students learn more in science using problem based learning.			100%	50%		50%		
6. The instructional method used in my class is effective for students with Learning Disabilities.			100%	50%		50%		
7. The teaching strategy used in my classroom allows for students to move at their own pace according to their academic levels.				50%	100%	50%		
8. Many students apply the content learned in class to other subject areas.			100%			100%		
9. There are many science related jobs and careers available to students in the county and state.	100%			100%				
10. All students benefit from a strong science education.			100%	50%		50%		

The results of the teacher survey reveal that the teacher using Inquiry-based instruction is very confident in the teaching method and feels his students respond well to it. All teachers report the teaching methods used in their classrooms are research based. All teachers reported the students in their class are actively involved at least 50% of the class time. 100% of teachers using inquiry-based instruction and 50% of teachers using teacher-centered instruction reported they disagree that the teaching strategy used in their classroom allows for students to move at their own pace according to their academic levels. Both regular education teachers reported they agree that the instructional method used in their classroom is effective for students with learning disabilities, however the special education teacher did not agree.

Teacher Comments

Two teachers gave additional comments on the survey. One teacher reported, “I feel that some children in ICS should be in the resource room setting, which is not an option at our school. These children struggle in a large class with the ability to maintain pace, the ability to read and write within the science curriculum, difficulty concentrating in a large classroom setting. The children tend to shut down when they feel the work is too difficult. Another teacher reported, “Students need problem solving skills to be successful in problem based learning. Students become easily frustrated with problem based learning activities.”

CHAPTER V

Discussion

Overview

The purpose of the study was to examine the effects of inquiry-based and teacher-centered instruction in teaching science for students with LD. The student performance scores of pre and post tests were compared to evaluate gains when these two instructional methods were provided.

The first research question addressed in the study was to examine student performance in learning science on the Cell Unit when inquiry-based instruction was provided. Students were assessed through pre and post tests during the three week when learning about cells, living things, and micro organisms. The mean of participants' pre test scores is 38. The mean of their post test score was 43. This yielded an average gain of 5% in student scores for those receiving inquiry based instruction.

In comparison to inquiry based instruction, students were taught using teacher-center instructional method in another school during the same three week instructional period. The mean of the pre test scores was 34, while their post test scores were 45, yielding an average gain of 11%.

When reviewing the test scores the students receiving teacher centered instruction performed 6% higher than those receiving inquiry-based instruction, which presented a significant difference between these two groups. The results support that students with learning disabilities score higher when teacher centered instruction is provided. There are several explanations for these results. The most prominent is that students with learning disabilities strive with the structural nature in the lesson delivery, students are required to follow directions

and participate in class practice. The information presented is later regurgitated on performance assessment. They learned the concepts and knowledge evidenced in their post test scores.

The second research question addressed the perceptions of students with learning disabilities on learning science when inquiry-based instruction is provided. 79% of students receiving inquiry based science instruction reported that they agree or strongly agree science is their favorite subject while only 50% of students receiving teacher-centered instruction reported science is their favorite subject. 99% of the students receiving inquiry based instruction reported that they enjoy science class, while 78% of students receiving teacher-centered instruction reported. There is a 21% discrepancy between the two groups. It seems that students enjoy learning during inquiry based instruction.

95% of students in the inquiry-based instruction indicated that they will have a career in science. Only 50% of students receiving teacher-centered instruction reported they will have a career in science. This reveals students receiving inquiry –based instruction like the subject area and want to continue their interests in science in the future.

When the survey data is compiled one can conclude that students receiving inquiry based instruction value science, science education, and the role science will play in their lives. They strive to have their careers in science and the related fields.

The third research question is related to the difference between students' performances when inquiry-based instruction is provided compared to that of teacher centered instruction. Student performance demonstrated that when receiving teacher-centered instruction their scores were 11% higher comparing to those receiving inquiry based instruction.

Summary

The findings of the study reveal that students with learning disabilities perform better when teacher-centered instruction was provided. However, the results of the student survey they are more likely to enjoy science when inquiry based instruction is provided.

Limitations

The study had some limitations. First, student scores may be impacted by other variables, rather than only teacher-centered instruction or inquiry-based instruction. These variables include teacher perception and interest in science, student motivation, interest, prior knowledge, and the learning environment. In the pre and post test the variables that can not be accounted for is maturation. That is simply by cognitive maturation and exposure, most students make some academic gains regardless of the technique or methodology. For example the pre test data for group 1 was 4% higher than group2. This could be due to a difference in prior knowledge between the groups.

In addition, the students' interest in the topics may attract their attention to become engaged, resulting in higher score in learning in that particular unit. The time frame of three weeks was very limited to detect a reliable increase in student performance. Another limitation of the study is the design of the testing assessment. The assessment was created using all multiple choice questions. The typical assessments in inquiry based instruction are problem solving questions with rated and scaled responses. While students in the teacher-centered group typically practiced in multiple choice questions they may give some benefits for their testing experience in the same format of assessment.

Finally, the number of students (30) and teachers (4) that participated was very low for a group design. The teacher personalities and their teaching styles may impact on the study too.

Recommendations

Based on the data collected, I would recommend several changes to improve the reliability of the study. First, the study should be repeated involving three groups of students and teachers from three different districts using inquiry based instruction compared to three groups of students and teachers in three different district receiving teacher centered instruction. This would create more reliable data to make decisions. Second, the study should involve an assessment composed of 15 multiple choice questions and 3 open ended questions with points given based on problem solving and the application of learned content and skills. Third, I would recommend running the study to discover if student responses change over time.

Through the research and participation of this study I would also recommend further study in the areas of inquiry-based instruction, transition, and career readiness in the areas of science education for students with learning disabilities.

Conclusions

Overall, both inquiry-based and teacher-centered instruction proved to have a positive impact on students with learning disabilities in learning science due to gained scores. Students with learning disabilities receiving teacher-centered instruction performed 11% higher on the assessments proving teacher-centered instruction is effective on teaching science to students with learning disabilities. However, students receiving inquiry-based instruction reported that they enjoyed learning science and would have their career in this field. Due to the fact that this study

was completed over three weeks, it was unable to evaluate the long term effects of inquiry-based instruction or teacher-centered instruction for students with learning disabilities in learning science.

This study has provided information in science instruction to demonstrate the learning outcomes of students with learning disabilities. I believe that if inquiry-based instruction was provided over time and related to vocational skills workforce it would show student achievement in their life and career. The students receiving inquiry-based instruction were able to internalize and value science education, which can be valuable overtime instead of only mastering content knowledge in the form of assessment.

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PRE/POST QUIZ
The Organization of Living Things

30 Questions multiple choice

1. The benefits of being a multicellular organism include _____

    a. small size, long life, and cell specialization
    b. generalized cells, longer life, and ability to prey on small animals
    c. larger size, more enemies, and specialized cells
    d. longer life, larger size, and specialized cells

2. Cells in a many-celled organism all _____

    a. have similar shapes
    b. are about the same size
    c. work together to keep the organism alive
    d. perform similar functions

3. Which term refers to cells having different jobs in an organism? _____

    a. multicellular
    b. specialization
    c. levels of organization
    d. unicellular

4. Cell size is limited by the _____

    a. thickness of the cell wall
    b. size of the cell's nucleus
    c. cell's surface area-to-volume
    d. amount of cytoplasm in the cell

5. What structure allows only certain things to pass in and out of the cell? ____
    a. cytoplasm
    b. cell membrane
    c. ribosomes
    d. golgi body

6. What is the smallest unit that can perform all the processes necessary for life?

a. Cell
b. Nucleus
c. Organelle
d. Protist

7. The first person to see cells with the microscope was ____?

a. Anton van Leeuwenhoek
b. Robert Hooke
c. Matthias Schleiden
d. Albert Einstein

8. Most cells are a very small size because
a. They don't have hard shells like eggs
b. Their volume does not decrease
c. Their surface area to volume ratio is too small
d. Their volume does not increase

9. What part of the cell forms a barrier between the cell and its environment?

a. Ribosome
b. Cell Membrane
c. Nucleus
d. DNA

10. What part of the cell acts as the cell's delivery system and makes Proteins?

a. Endoplasmic Reticulum
b. Mitochondria
c. Nucleus
d. Cell Wall

11. What part of the cell keeps all the organelles in place?

a. Cytoplasm
b. Vesicles
c. Lysosomes
d. DNA

12. Larger size, longer life and specialization are three benefits to being

a. Prokaryotic

b. Unicellular
c. Multicellular
d. No cells

13. What part of the cell is where ATP is made and stored in the inner membrane and used for energy?

a. Golgi Complex
b. Nucleus
c. Endoplasmic Reticulum
d. Mitochondria

14. What is the function of the Lysosome in the cell?

a. Store water
b. Digestive activities
c. Make proteins
d. Energy

15. What are the tiny round organelles that are made of protein and attached to the endoplasmic reticulum?

a. Ribosomes
b. DNA
c. Eukaryote
d. Eubacteria

16. What cell part made of cellulose and chitin supports the cell and is found only in plant cells?

a. Nucleus
b. Cell Membrane
c. Cell Wall
d. Organelles

17. Specialization in cells makes tissues, organs, and systems

a.. Grow Large in size
b. Produce Larger cells
c. Stay Healthy
d. Work more efficiently

18. Where do cells come from?

a. Plants
b. Cells

c. Eggs
d. Ponds

19. Where does photosynthesis take place in a cell?

a. Mitochondria
b. Nucleus
c. Chloroplast
d. Ribosomes

20. What does the Golgi Complex(Golgi body) do in a cell

a. It packages and distributes materials out of the cell
b. It is the power source of the cell
c. It makes sugar and oxygen
d. It makes proteins

21. _____ All living things get energy either directly or indirectly from the

A. Animals
B. Plants
C. Sun
D. Water

22. _____ Keeping a constant body temperature in the cold, or increasing your breathing rate when you run, are considered examples of

A. Homeostasis
B. Warm-blooded
C. Budding
D. Metabolism

23. _____ A type of reproduction that requires two parents is called

A. Asexual Reproduction
B. Simple division
C. Spontaneous generation
D. Sexual Reproduction

24. _____is part of a cell that is only found in Plant cells which provides support and protection for the cell.

a. plankton
b. chlorophyll

c. cell wall
d. xylem

25. _____What are all of the characteristics of living things?

a. made of cells, use energy, grow and develop, reproduce, respond and adapt to their environment
b. grow and reproduce

26. The genetic material in cells is called the _____?

a. DNA
b. Ribosomes
c. Endoplasmic Reticulum
d. brain

27. _____are cells with a nucleus.

a. DNA
b. Brain
c. Eukaryotes
d. cell wall

28. _____is the organelle made up of proteins and RNA

a. Eukaryotes
b. Brain
c. ribosomes
d. cell wall

29. _____ is made up of cells

a. paint
b. sunshine
c. toes
d. plastic

30. A structure that is made up of two or more tissues working together is a(n) ____?

a. tissue
b. cell wall
c. organ
d. cell membrane

Appendix B. Student Survey

Please circle one response to following statements.

1. Science is my favorite class.

Strongly Agree Agree Disagree Strongly Disagree

2. I enjoy science class.

Strongly Agree Agree Disagree Strongly Disagree

3. My favorite part of science is doing labs.

Strongly Agree Agree Disagree Strongly Disagree

4. I participate in science class activities and experiments.

Strongly Agree Agree Disagree Strongly Disagree

5. I feel my science class moves at an appropriate pace to me.

Strongly Agree Agree Disagree Strongly Disagree

6. I will use the information I learned in my science class in my life.

Strongly Agree Agree Disagree Strongly Disagree

7. I typically receive a grade of A or B in science.

Strongly Agree Agree Disagree Strongly Disagree

8. Science has value in my life.

Strongly Agree Agree Disagree Strongly Disagree

9. I will have a career in a science field.

Strongly Agree Agree Disagree Strongly Disagree

10. I like the way my science class was taught.

Strongly Agree Agree Disagree Strongly Disagree

Appendix C. Teacher Survey

Please circle one response to each of the following statements.

1. I have had official training in Teacher Directed or Inquiry-Based instruction.

Strongly Agree Agree Disagree Strongly Disagree

2. The students respond well to the teaching style used in my classroom.

Strongly Agree Agree Disagree Strongly Disagree

3. I think my current instructional strategy is researched based.

Strongly Agree Agree Disagree Strongly Disagree

4. My students are actively engaged in 50-75% of the class time.

Strongly Agree Agree Disagree Strongly Disagree

5. I think all students learn more in science using problem based learning.

Strongly Agree Agree Disagree Strongly Disagree

6. The instructional method used in my class is effective for students with Learning Disabilities.

Strongly Agree Agree Disagree Strongly Disagree

7. The teaching strategy used in my classroom allows for students to move at their own pace according to their academic levels.

Strongly Agree Agree Disagree Strongly Disagree

8. Many students apply the content learned in class to other subject areas.

Strongly Agree Agree Disagree Strongly Disagree

9. There are many science related jobs and careers available to students in the county and state.
Strongly Agree Agree Disagree Strongly Disagree

10. All students benefit from a strong science education.

Strongly Agree Agree Disagree Strongly Disagree

Please add any additional comments below or on the back: