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High school teachers' perspectives on effective approaches for teaching biology to students with special needs

Agnieszka Kos
Walden University

Walden University

COLLEGE OF EDUCATION

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Agnieszka Kos

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Review Committee
Dr. Laura Lynn, Committee Chairperson, Education Faculty
Dr. Kurt Schoch, Committee Member, Education Faculty

Chief Academic Officer

Denise DeZolt, Ph.D.

Walden University
2010

Abstract

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MA, Saint Xavier University, 2000

BS, University of Illinois, 1997

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

The demands of national educational reforms require high school biology teachers to provide high quality instruction to students with and without special needs. The reforms, however, do not provide teachers with adequate teaching strategies to meet the needs of all students in the same context. The purpose of this grounded theory study was to understand high school biology teachers' perspectives, practices, and challenges in relation to teaching students with special needs. This approach was used to develop a substantive model for high school biology teachers who are challenged with teaching students with and without special needs. Data were collected via in-depth interviews with 15 high school teachers in a Midwestern school district. The data were analyzed using open coding, axial coding, and selective coding procedures in accordance with the grounded theory approach. Essential model components included skills and training for teachers, classroom management strategies, teaching strategies, and student skills. The emergent substantive theory indicated that that teacher preparation and acquired skills greatly influence the effectiveness of inclusion implementation. Key findings also indicated the importance of using of a variety of instructional strategies and classroom management strategies that address students' special needs and their learning styles. This study contributes to social change by providing a model for teaching students and effectively implementing inclusion in regular science classrooms. Following further study, this model may be used to support teacher professional development and improve teaching practices that in turn may improve science literacy supported by the national educational reforms

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ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

Dedication

This dissertation is dedicated to my parents and family who believed in me and were there to support me every step of the way.

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I would like to thank my dissertation committee members. Without your expert knowledge and support this tremendous task would not be accomplished. My committee chair and mentor, Dr. Laura Knight-Lynn, guided and provided me with thoughtful feedback and support along the way of my dissertation process and a KAM work. I am also thankful for encouragement to continue my scholarly work beyond the doctoral studies. Dr. Sigrin Newell worked with me through KAMs and prospectus, provided guidance, support, and thorough feedback in my doctoral work. Dr. Douglas Eicher provided expert knowledge of special education and guidance in the dissertation process.

I would like to express my sincere gratitude to Mark Myslinski for participation in this study as a peer reviewer who contributed to improving the validity of this study. I would also like to express my gratitude to the participants in this study for taking their valuable time and sharing their expert knowledge that contributed to the completion of this dissertation.

I would like to thank all of my family, friends, and colleagues who were always there when I needed their encouragement and support. Finally, I want to express my gratitude to my beloved husband. Thank you for your support in my Walden journey.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Introduction

Students with special needs have difficulties learning biology in a regular classroom. In fact, biology, among other sciences and math, had the highest failure rate as reported by the American Association for the Advancement of Science (1998, p. 10). This is further supported by SAT scores indicating that students with disabilities scored lower in science and math when compared to other subject areas (p.10).

This problem was recognized by policymakers and teachers who have high expectations of all students, with and without special needs. The teachers are the pivotal factor in ensuring that all students meet the state requirements. In this regard, a grounded theory study was conducted and guided by the following research questions: What are high school teachers' perspectives on how students with special needs learn science concepts in biology? What obstacles/challenges do teachers face in instructing students with special needs? What strategies do high school biology teachers use to teach students with special needs?

This study investigated influencing factors and their relationships for building a substantive model by exploring the following factors: national reforms; teachers', parents', and students' perspectives towards inclusion; stress involved in teaching students with special needs; and the teaching strategies for inclusive biology. The substantive model from this study will enable present and future biology teachers to improve their teaching strategies in instructing students with and without special needs.

Problem Statement

There is an increasing number of school age individuals with disabilities who are taught in general education classrooms (i.e. with students who do not have disabilities) and who are serviced under the Individuals with Disabilities Education Act (1990). The number of individual students served under IDEA by disability and age group 3-21 was more than six million between 1998 and 2007 (Data Accountability Center, n.d.). Regardless of these escalating numbers of individuals with disabilities, the national educational reforms No Child Left Behind Act (2001), Project 2061 (1998), and the National Science Education Standards (1996), place continuously higher demands on improvement of science literacy for all students.

Being science literate is of paramount importance not only to students who are required to pass achievement tests, but also to every citizen. Students who learn biology develop the critical thinking skills and problem solving skills necessary in their everyday lives. Biological literacy provides students with the foundation to understand their own bodies and the environment in which they exist. Also, as consumers, students need to make adequate judgments about the products they purchase, as such products will influence the well being of students and the well being of the environment. All of these skill sets are facilitated by science literacy.

Thus far, it is evident that learning biology is important, but it is yet challenging to high school biology teachers who are not equipped with adequate teaching strategies to accommodate all students in the same classroom. The literature on science pedagogy provides teaching strategies for science; the literature also provides teaching strategies for

students with special needs. However, the guidance on theses approaches is limited in that they are presented separately (Colburn, 2004 & Fuchs, Fuchs, & Burish, 2000). This study aimed to fill the gap between these two fields which explored how high school biology teachers teach students with special needs who are enrolled in their regular high school biology course. A substantive model was developed that reflects the actual teaching strategies employed by high school biology teachers.

Nature of the Study

This research study employed a grounded theory design. This method allowed me to study phenomena that are not easily measured as in positivist paradigms. The qualitative paradigm takes an interpretative approach where I (as the qualitative researcher) learned "how individuals experience and interact with their social world, [and] the meaning it has for them" (Merriam, 2002, p. 4). Grounded theory was chosen for this study because it enabled me to develop a model that future biology teachers and special education teachers may use to instruct high school biology students with and without special needs.

My role in this study was primarily that of observer-as-participant. As such, I chose convenience sampling (nonrandom) and examined 15 high school biology teachers who teach special needs students in a general classroom. The participants were asked to participate in the study via semi-structured phone interviews. The qualitative data generated from the phone interviews were coded and analyzed according to the grounded theory tradition. The data were coded in a search for relationships and themes in the data.

Research Questions

1. What are high school teachers' perspectives on how students with special needs learn biology?
2. What obstacles/challenges do biology teachers face in instructing students with special needs?
3. What strategies do high school biology teachers use to teach students with special needs?

The nature of this study and the research questions will be discussed in more detail in chapter 3.

Purpose

The purpose of this grounded theory study was to understand high school biology teachers' perspectives, practices, and challenges in relation to teaching students with special needs. A substantive model was developed for high school biology teachers who are challenged with teaching students with and without special needs. The model may help teachers improve their instructional practices.

Conceptual Framework

The framework used in this study was a conceptual framework called the perpetual cycle of improvement that was based on my experiences in the field and the pilot study. A conceptual framework was chosen over the theoretical framework because the conceptual framework is "the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs" (Maxwell, 2005, p. 33) in this research study. A theoretical framework was not used in this study because a theory was not able to

accommodate all the data and their relationships equally (Maxwell, 2005, p. 43). Furthermore, no specific theory or theories guided the questions or perspectives in this study. Instead, a conceptual framework, developed by myself, guided this study.

In order to provide guidance for this research study, the conceptual framework emerged and solidified from the teachers' responses to a pilot interview questionnaire and is depicted in a graphical model called the perpetual cycle of improvement. This model was based on teachers' practices and perspectives on how they teach biology to students with and without special needs. This model consists of five major elements: (1) high school biology teachers' perspectives on how to instruct students with special needs in a regular classroom, (2) skills required and skills used by students, (3) obstacles/challenges in biology classrooms, (4) teaching strategies, and (5) classroom management strategies (Figure 1).

In this study, the perpetual cycle of improvement framework was used to explore its further development of these concepts and relationships. During this study the framework developed by me was expanded to fit the practices and perspectives of high school biology teachers faced with teaching students with and without special needs. I focused on learning more about the five elements and their relationships that form the perpetual cycle of improvement.

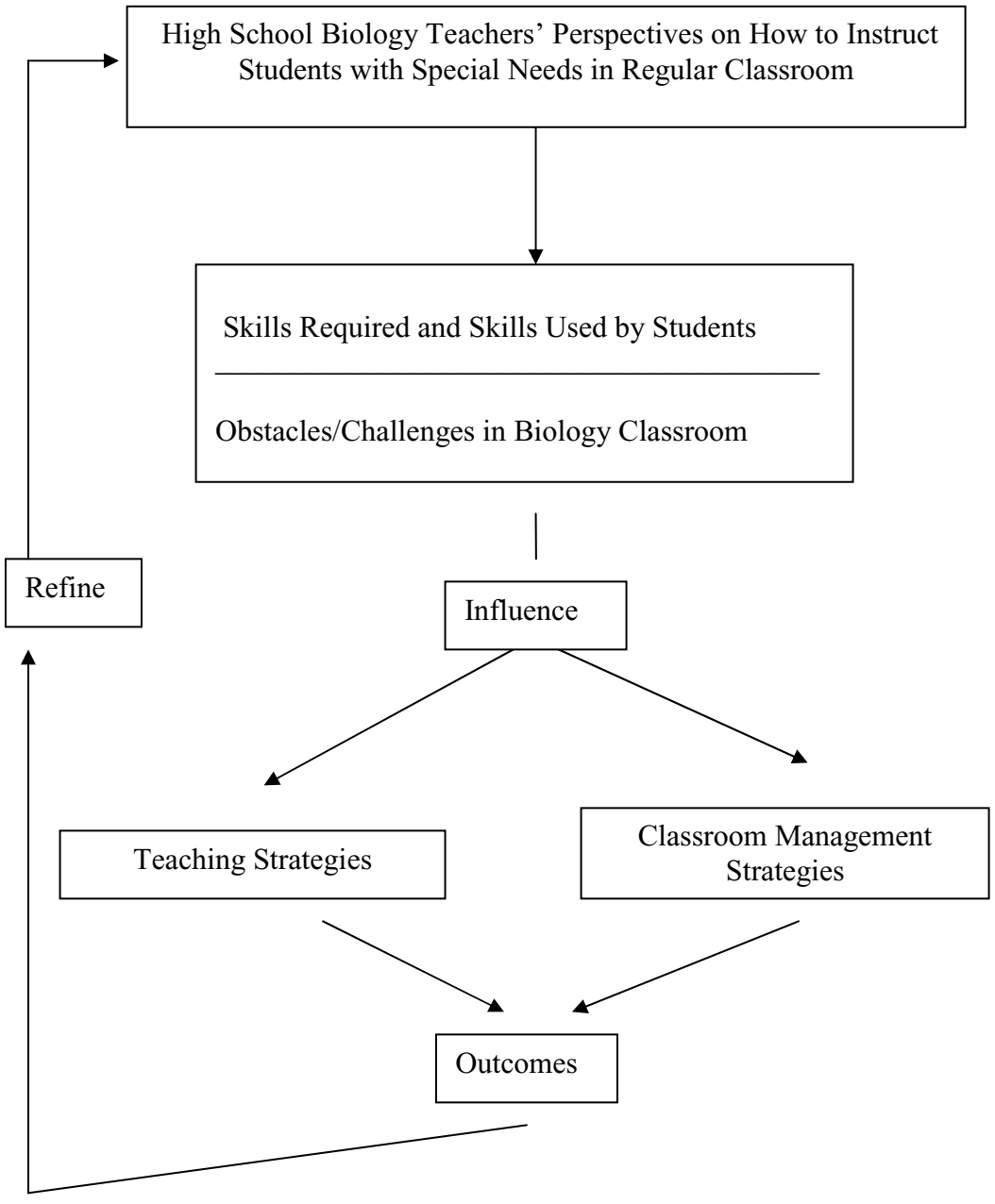

Figure 1. Perpetual cycle of improvement

Operational Definitions

Definitions below convey how specific terms were used in this study

Cooperative Learning is when students work together to accomplish shared learning goals and maximize their own and their group mates' achievement (Johnson, Johnson, & Holubec, 2002, p. 222).

Disability is a condition characterized by a cognitive or social difficulty so severe that it negatively affects student learning (Friend & Bursuck, 1999, p. 487).

Inclusion is a term used to describe a professional belief that students with disabilities should be integrated into general education classrooms and should be full members of those classrooms whether or not they can meet traditional curricular standards (Friend & Bursuck, 1999, p. 489).

The Individuals with Disabilities Education Act (IDEA) is a law ensuring services to children with disabilities throughout the nation. IDEA governs how states and public agencies provide early intervention, special education and related services to more than 6.5 million eligible infants, toddlers, children and youth with disabilities (www.IDEA.gov).

Mainstreaming is used to describe the placement students with disabilities in general education settings when they can meet traditional academic expectations with minimal assistance (Friend & Bursuck, 1999, p. 490).

Special Education is a type of instruction that accommodates specific needs of a special needs student (Friend & Bursuck, 1999, p. 487).

Students with Special Needs are students with learning disabilities who are eligible to receive special education services (Friend & Bursuck, 1999, p. 2).

Assumptions

1. All students with special needs in participating district receive instruction in a regular biology classroom.
2. Each student with special needs has his/her individual education plan (IEP) established.
3. Biology teachers have some preparation to accommodate students with special needs in a regular biology class.
4. Biology teachers cooperate with special education teachers to serve students at their optimum level.
5. Special education teachers have adequate training.

Scope and Delimitations

The scope of the study extended to an exploration of high school teachers' perspectives and teaching methods related to how students with special needs learn science in a regular biology classroom. The study included 15 high school biology teachers who agreed to participate in the study via phone interviews. Phone interviews were conducted in order to gather information efficiently and conveniently for teachers during their out of school time. Probes were used, as needed to facilitate rich responses. Students were not included in this study and there were no classroom observations.

There was no attempt to evaluate students' individual education plan to determine whether the teacher adequately accommodates the special needs students in his/her

biology classroom. Further, the identified teaching methods and perspectives were not tested on the students. Finally, educational levels of the biology teachers were not discussed or evaluated.

Limitations

In this study there were three limiting factors. The first limiting factor that influenced the results of this study was the small number of participants. This purposive sample was chosen so as to glean in-depth qualitative information. Secondly, this study examined only biology teachers who teach students with special needs in their regular biology classroom. Insights gained from this study may be helpful to other biology teachers who work with students with special needs and also may be applicable to other subject areas. While this is true, it is important that the findings are considered within the confines of the specific sample and work context of subjects. Additional studies would be needed to determine the generalizability of these results for those working in special needs classrooms in other contexts. The third limiting factor involved the conducting of telephone interviews as opposed to face-to-face interviews. During the phone interviews the lack of visual cues/facial expressions may pose difficulties in the interpretation of the responses.

The Significance of the Study

This grounded theory study approach allowed for an in-depth understanding of high school teachers' perspectives on how they teach biology concepts to students with special needs who are included in a regular biology course. Doing so may be helpful to other high school biology teachers who are faced with educating a diverse student

population that includes students with special needs. The outcomes of this study may be applicable across other subject areas such as chemistry, physics, or even social sciences.

Furthermore, the outcomes of this study may be significant to students with and without special needs, who participate in the same biology classroom. The teachers who adopt and implement the methods generated in this study may become skilled at helping their students better understand and learn biology concepts.

Administrators may also find the outcomes of this study important. They may use the results to help their regular education teachers as well as special education teachers by providing professional development sessions to address methods employed by teachers in presenting biology concepts. Furthermore, policy makers may find this study relevant since they are concerned with the educational needs and practices that impact all students.

The goal of educational reform is to implement change in the education system. As such, it mandates that current and future teaching practices must provide high quality education to all students. This indicates that students with and without special needs are to demonstrate a high academic proficiency level in all core subject areas. Therefore, regular biology teachers need to instruct students in such a way that all students' abilities are addressed in teaching practices to improve proficiency in biology learning. Through this study a model will be developed that current and future teachers may use to improve their teaching practices. In turn, this model may be used to help inform the writing and revision of current educational policies influencing students with special needs.

Organization of the Remainder of the Study

Chapter 2 of this research study explores the current literature in terms of teachers', parents', and students' perspectives in regard to instructing students with special needs in an inclusive context. This chapter discusses the challenges faced by teachers when instructing students with special needs in regular classrooms. Furthermore, statewide policies implemented in inclusive classrooms are discussed. Chapter 2 also discusses strategies high school teachers use to teach students with special needs in a biology classroom. In chapter 3, the methodology of this study is discussed. Chapter 3 includes a description of research design and approach, setting and sample, data collection, and data analysis procedures. Chapter 4 reveals the process, by which the data were generated, gathered, and recorded. Findings supported by the data, discussed and laid out, in detail, the data analysis methods. Chapter 5 of this study provides a discussion of the study results and how they impact high school biology teachers and their students. The final chapter also considers how the results of this study may contribute to social change.

Chapter 2: Literature Review

Content of the Literature Review

The review of literature for this study is related to research on the importance of science teaching in general as well as science teaching for students with special needs who are taught in the same context as typical students. The review examined literature on different attitudes toward including students with special needs in general classrooms. In addition, the review examined different instructional strategies recommended for biology students with and without special needs at the high school level.

The problem statement and research questions of this study were closely related to the review of literature. The problem statement argued that there is an increasing number of students with special needs who are mandated to take regular high school biology with students without special needs (Data Accountability Center, n.d.; NRC, 1996; AAAS, 1998). However, there was not enough information that addresses how high school biology teachers should instruct such a diverse student population. The intent of this study was to understand high school biology teachers' perspectives, challenges, and practices in relation to students with special needs in general biology classrooms.

The following research questions are closely tied to the problem statement:

1. What are high school teachers' perspectives on how students with special needs learn biology?

2. What obstacles/challenges do biology teachers face in instructing students with special needs?

3. What strategies do high school biology teachers use to teach students with special needs?

This review of the literature focused on the importance of science and science instruction for students with and without special needs. Furthermore, the review of literature described attitudes toward including students with special needs in general education classrooms. The review of literature also described the obstacles and challenges teachers faced in instructing students with and without special needs. Finally, the different instructional strategies were explored and adopted to meet the needs of students in special education enrolled in general biology classroom.

Organization of the Review

The review of literature for this study is organized in the following manner: (a) importance of science, (b) science teaching, (c) inclusion, (d) teaching strategies for inclusive biology, (e) literature related to the methods reviewed, (f) literature related to the use of differing methodologies, (g) summary and conclusion.

Search Strategies

The literature search was accomplished by using the keyword search strategy involving various electronic databases such as Academic Search Premier, ERIC, Education Research Complete, and PsycINFO. Some of the keywords used to search the databases are as follows: *inclusion, instruction, science, teaching strategies, instructional strategies, learning, disability, and inquiry.* Through the databases a wide range of peer-reviewed journals were identified and used in this literature. Mainly, the journals were related to science education, special needs education, and learning disabilities. Included

were *Science Scope, Texas Science Teacher, The American Biology Teacher, Journal of Special Education, and Journal of Learning Disabilities*. In addition, governmental publications were searched for information regarding national trends in the science education of students with special needs, national science education standards, national center for education statistics, and the high school leadership summit issue papers. The databases were accessed through Walden University Library along with the Saint Xavier University Library located in Chicago.

Importance of Science

Science and Society

Science has been defined as "the study of nature in an attempt to understand it and to create new knowledge that provides predictive power and application" (Chiappetta et. al., 1998, p. 4). This new knowledge is applied and affects our daily lives, our society and our ability to compete in a global business world known as globalization. Due to the application of the new knowledge, transportation, communication, technology, and electronics have evolved in such a way that information and products can travel across the globe extremely fast and at a low cost (Mintzes, Wandersee, & Novak, 1998, p. 24). Similarly, the Tofflers (1995) addressed knowledge as an important resource of our economy because it improves existing products by producing smaller and lighter products. From this application of new scientific knowledge, warehousing and transportation costs have decreased (pp. 37, 38).

Dewey (1916/2005) considered science as the main factor that drives social progress (p. 270). This progress, however, is affected by education that is responsible for

the modification of teaching methods and curriculum to meet the needs of an evolving society (Dewey, 1902/2001, p. 6). Our society and its economy require schools to adequately prepare young students for 21st century life – that is, to prepare them for careers that demand "higher levels of reading, communication, math, and problem solving skills than ever before" (U. S. Department of Education, 2007, p.1). In addition, global economic competition and homeland security concerns call for high quality instruction not only in math but also in science (U. S. Department of Education, 2003a, para. 11).

Science and National Reform

In response to the current challenges, President Bush called for national K-12 education reforms through the No Child Left Behind Act (NCLB) of 2001. According to the High School Leadership Summit, which was held in October, 2003, the purpose of the law is "to close the achievement gap between disadvantaged and minority students and their peers and to change the culture of America's schools so that all students receive the support and high quality instruction they need to meet higher expectations" (U. S. Department of Education, 2003b, p. 1). The high quality instruction should be provided in science classrooms as well as in other core subjects such as English, reading, mathematics, foreign language, economics, arts, history, social science, and geography (U. S. Department of Education, 2003b, p. 2).

To close the achievement gap and provide high quality education in the core subjects, NCLB requires all states to "establish annual achievement objectives for all high schools" (U. S. Department of Education, 2003b, p. 1). The objectives are stated in

"adequate yearly progress" (AYP) and are specifically tailored for every state. These objectives are monitored throughout the year to ensure steady progress of proficiency in the core subjects by the end of the 2013-2014 school year (U. S. Department of Education, 2003b, p. 1).

In support of the NCLB, states are also required to monitor the progress of all students. In doing so, states must establish annual achievement goals for all students. Among the students being assessed are those who come from low-income families, those of different race and ethnicity, and those who possess low English proficiency or are disabled. The achievement goals are intended to facilitate every student's proficiency level, and to help him or her meet the 100 % proficiency requirements (U. S. Department of Education, 2003b, p. 1).

States are also required to report and be accountable for high school graduation rates. "Graduation rate is defined by the law as the percentage of students who graduate from high school with a regular diploma in the standard number of years" (U. S. Department of Education, 2003b, p. 1). In addition, states must report the graduation rates for the students who are at greatest risk of dropping out of school (U. S. Department of Education, 2003b, p. 1).

The last requirement of NCLB is to "give parents and community leaders the information they need to hold high schools accountable and support improvement" (U. S. Department of Education, 2003b, p. 2). This information is to be reported by every state in school report cards that are available for public viewing. The information should include student progress and their achievement on state assessments. Furthermore, the

information should be grouped accordingly to students' "race, ethnicity, gender, English language proficiency, migrant status, disability status and low-income status" (U. S. Department of Education, 2003b, p. 2). In addition, student graduation rate and teacher qualifications should be included among other indicators that support improvement (U. S. Department of Education, 2003b, p. 2).

Science Teaching

Science encompasses a variety of subfields: biology, chemistry, physics, and geology. These subjects are saturated with many technical terms and theories that students are expected to learn. Often times educators present and teach the subjects in a simplified manner that is, they present only the outcomes of scientific investigation without making connections to the students' experience or how the scientists arrived at a theory. Early in the twentieth century, such a teaching approach was not recommended by Dewey (1916/2005), who stated that "The pupils learn a 'science' instead of learning the scientific way of treating the familiar material of ordinary experience" (p. 256). He also emphasized that being in contact with laboratory instruments and laboratory exercises does not translate into learning the scientific way because the use of laboratory instruments "do not as a matter of course constitute scientific method" (p. 259) even though they are necessary in conducting scientific investigations.

In the 21st century, science educators continue to build on Dewey's ideas. Chappetta and colleagues (1998) illustrate this support of Dewey's work, stating that the thinking process, or the ways knowledge is constructed, is omitted when teachers simply present the scientific information. This process - of simply presenting information to

students - results in the rote memorization of presented facts that are meaningless to students (p. 102). Rote memorization may result in passing grades, but not in learning (Mintzes et. al., 1998, p. 8).

Brooks and Brooks (1999) stated that we construct understanding when we interact with objects and ideas. This means that we construct new understanding based on previous experiences. The new information is compared with what we already know and determines if the new data can be explained by an existing set of rules. Sometimes the previous experiences do not offer enough explanation for new phenomena. As a result, one needs to develop a new set of rules to make sense of the new experiences. In other words, our perceptions and rules are continuously questioned as we learn new things or concepts (p. 5).

A parallel conclusion is made by Bahar (2003) who stated that students do not learn new material by simply transferring the material from the head of the teacher to the head of the students. When the teacher presents the new material, students reconstruct the new knowledge because every individual is different in terms of their motivational patterns and prior knowledge held by the individuals (p. 472). This is also in line with Johnson, Johnson and Holubec (2002) who stated, "Knowledge is constructed, discovered, transformed, and extended by students" (p. 202). The teachers' job, however, is to provide learning opportunities and conditions for the students to construct their knowledge.

Inquiry as a Construct of Knowledge

To construct understanding that is meaningful calls for the implementation of inquiry in teaching biology and other sciences. Inquiry is a term that characterizes "the active processes involved in scientific thinking, investigation, and the construction of knowledge" (Chiappetta et. al., 1998, p. 102). These inquiry processes may help students improve their scientific literacy. Lord and Orkwiszewski (2006) reported positive outcomes from implementing inquiry-based instruction in a biology classroom. Students who learned through inquiry performed better on weekly quizzes than students who learned through traditional modes of instruction. In other words, students who designed their experiment learned more biology concepts than students who were instructed to follow a step-by-step procedure provided by the lab manual (p. 345).

The strength of inquiry-based instruction is also revealed by Hammerman (2005), who noted that inquiry based instruction promotes understanding of new concepts. The implementation of inquiry-based instruction also promotes development of critical thinking skills. Furthermore, through inquiry-based instruction students learn about relationships among science, technology, and society (p. 31).

Furthermore, students will learn to think critically and independently, which in turn will help them develop problem solving skills that are necessary in biology class, other science courses, and in everyday life (Colburn, 2004, p. 66; NRC, 1996, p. 1). Implementation of inquiry in teaching science may involve two approaches, teaching by inquiry and teaching as inquiry.

Teaching science by inquiry. Teaching by inquiry involves creation of a learning environment where students are engaged in the process of finding out. To do so, the teacher needs to plan ahead to develop provoking questions and events that stimulate the mind of the student who is eager to find out the answer. Students acquire scientific attitudes or attributes of scientists as they are engaged in finding out, which should also benefit students as they construct and attain new knowledge. In this process students "develop certain reasoning skills, patterns of thinking, and habits of mind that they can use throughout their lives" (p. 102).

Teaching science as inquiry. This approach does not involve discovering by doing; instead students learn how scientific knowledge or concepts were attained. Thus, this approach involves students' engagement in the mind of the scientists where students follow how the scientist(s) arrived at the new knowledge/concepts. In doing so, they trace the steps and thinking processes the scientists have undertaken to confirm, modify, accept, or reject their findings. Such activity engages students to align their thinking with objects and events they have experienced. In turn, the aligning of thinking with experiences leads to knowledge formation (Chiappetta et. al., 1998, pp. 105-108).

Types of Inquiry

Colburn (2004) identified three types of inquiry-based instruction: structured inquiry, guided inquiry, and open inquiry. Structured inquiry involves students who are instructed to follow step-by-step procedures in a laboratory manual however students are required to create their own data table based on their observations and to determine the meaning of the collected data.

In guided inquiry students are required to do the same as in the structured inquiry (determine what data will be collected and how they will be interpreted), but they are also required to design their own procedure to help them answer a question(s). The teacher's role is to state the question(s) and distribute lab materials. Students are to decide what they will do and how. These decisions are to be communicated in the procedure. Such approach generates different procedures developed by different groups that may result in the same findings.

Open inquiry involves students who make most of the decisions about conducting an experiment. In other words, students are to state the question/hypothesis, write their own procedure, create data tables/graphs, decide what and how data will be collected and analyzed. The teacher, on the other hand, may instruct students to investigate factors (without revealing them) that may affect the outcome of the experiment (pp. 64-65).

Views on Inquiry-Based Instruction

To meet the National Science Education Standards teachers are required to have a strong science background and "Understand the nature of scientific inquiry, its central role in science, and how to use the skills and processes of scientific inquiry" (NRC, 1996, p. 59). Lord and Orkwiszewski (2006) concurred, stating that "All science professors should consider teaching through inquiry challenges" (p. 345) because students learn and retain their knowledge and are able to apply the skills they learn in new situations. They also become enthusiastic about science and develop a personal interest in science.

Conducting inquiry-based instruction is not always simple, for it is often misunderstood (Aoki, Foster, & Ramsey, 2005, p.19; Chiappetta, 1998, p. 103). The lack

of understanding is reported by Aoki and colleagues, who concluded that science supervisors did not comprehend that through inquiry instruction students construct their knowledge, which in turn affects students' personal perspectives, social perspectives, attitude, creativity, and understanding of the nature of science. Instead, they thought that inquiry-based instruction involves only physical manipulation with objects such as instruments or chemicals (p. 19). Such manipulations or hands-on activities alone will not result in learning science because learning science is an active process that involves students who "must have 'minds-on' experiences as well" (NRC, 1996, p. 2).

In contrast, some instructors viewed inquiry as discovery or discovery of concepts by the students which would give them some ownership in their learning. Furthermore, they felt that inquiry based instruction is characterized by more strengths than weaknesses and they recommended that the pre-service teachers implement this method in their teaching (Withee & Lindell, 2006, p. 127).

Chiappetta (1998) noted the importance of learning the science inquiry process skills to the work of constructing new knowledge. These process skills involve "posing questions, stating problems, making accurate observations, classifying data, providing inferences, communicating findings, and conducting experiments" (p. 110) and are in line with National Science Education Standards (NRC, 1996, p. 23).

Implementing intensive inquiry that entails all of the science process skills is cumbersome to some science teachers due to time constraints. Implementing full inquiry does not allow teachers to cover all of the material that will be included on standardized tests. Science teachers feel pressured to teach to the test, thus inquiry-based instruction is

deemphasized (Chiappetta, 1998, pp. 127, 128). Similarly, Wilke and Straits (2006) reported time constrains to implementing inquiry-based instruction. To remedy the problem they encouraged science teachers to teach process skills independently. Further, they recommended routine teaching of these skills because that will "increase likelihood that students will learn the skills." Once students master the skills, they will be more successful in conducting intensive scientific inquiry (p. 16).

Another obstacle in implementing an inquiry approach involves student confusion about the employment of inquiry. Students tend to be engaged with lab materials but their minds are elsewhere; they are confused about what they are supposed to be discovering and how. This problem to some extent may stem from inadequate education and training of the science teachers because they were not exposed to an inquiry-based instruction model (Chiappetta, 1998, p. 128). Thus, having a foundation in science process skills should be a prerequisite for science teachers in order to implement inquiry-based instruction.

Biology as Inquiry

The National Science Education Standards encourage science teachers (e.g., biology teachers) to employ inquiry-based instruction that is listed in content standard A. This standard expects all students in grades 9-12 to develop abilities necessary to do scientific inquiry and to develop understandings about scientific inquiry (NRC, 1996, p. 173). Thus, to learn biology concepts students must be able to:

1. Identify questions and concepts that guide scientific investigations.
2. Design and conduct scientific investigations.

3. Use technology and mathematics to improve investigations and communications.
4. Formulate and revise scientific explanations and models using logic and evidence.
5. Recognize and analyze alternative explanations and models.
6. Communicate and defend a scientific argument. (NRC, 1996, pp. 175, 176)

Science for All Students

The National Science Education Standards provide a framework to teach science to all students "regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science" (NRC, 1996, p. 2). The Standards emphasize that students will learn science in different ways and will develop an understanding at different levels, however "all students can develop the knowledge and skills described in Standards" (p. 2). This means that all students, including those with learning disabilities, should be able to learn biology via inquiry-based instruction.

In support of science literacy for all American students, the American Association for the Advancement of Science (AAAS) has initiated a reform movement by developing Project 2061. The main goal of this project is to produce a science literate population by year 2061 (1998, p.1). A similar goal is envisioned and enforced by the No Child Left Behind Act that requires "all students, including students with disabilities, be held to the same challenging grade-level standards" (Spellings, 2005, p. 16). The goals of NCLB are to be achieved much sooner, i.e. by the 2013-2014 school year.

The advocates of NCLB have recognized that some disabled students may not be able to achieve the grade level standards due to cognitive disabilities. A new policy is enforced to accommodate such students. It permits educators to administer the standardized proficiency assessment to only 1 % of all students with disabilities in a district or school. If this policy were not so flexible then the standardized test scores of students with disabilities would be measured against test scores of students without disabilities and thus the scores would not meet the expectations of NCLB (Cohn, 2007, p. 1).

The NCLB still expects students with disabilities to meet achievement standards for a grade level, however their assessment is alternative to accommodate students' cognitive disabilities. This achievement standard may be difficult to meet since more than six million school age individuals are served under the Individuals with Disabilities Education Act (IDEA) and are taught in general education classrooms (U.S. Department of Education, 2003). Also, the AAAS stated, "All students with disabilities do have potential in science" (p. 10). However, to reach the potential certain accommodations need to be provided, otherwise students may be misunderstood or unable to communicate clearly. Some students (those with learning disabilities) may require simple accommodation such as more time to complete science activities (AAAS, 1998, p. 10; NRC, 1996, p. 37).

Inclusion

The national education reforms (NCLB, Project 2061, and the Standards) support science education for students with special needs and stem from three federal laws:

Public Law 94-142, Public Law 101-476, and Public Law 101-336. These laws resulted in full inclusion of students with special needs in regular classrooms, thus students are placed in a least restrictive environment (Chiappetta, 1998, pp. 54, 55). Abu El-Haj (2006) defined full inclusion as "an idea premised on an iteration of civil right discourse that rejects the segregation of students labeled with disabilities. Students labeled with disabilities should be served in classrooms with their non-labeled peers to the greatest extent possible" (p. 63).

Similarly, Hodkinson (2005) found that teacher trainees defined inclusive education as an education where all students are included and treated equally. In addition, the teacher trainees reported that the needs of each student should be considered and facilitated to reach their full potential. The definition of inclusive education entailed not only students with special needs but also extended to students of different ethnicity, religion or beliefs, gender, social status, disability, ability, and age (pp. 22, 23).

Abu El-Haj (2006) expressed skepticism about equity in practice, stating that students with special needs included in a regular classroom are forced to assimilate to the instructional practices of the instructor. In other words, all students are taught in the same way, disregarding students with special needs who require instructional modifications (p. 64). These assertions are in line with Hodkinson's (2005) study. The teacher trainees could define inclusive education but they had difficulties in its implementation. They did not modify curriculum to meet the instructional needs of students with special needs (p. 23).

In their definition of inclusion Friend and Bursuck (1999) also did not mention adaptation of curriculum to students' needs; instead they stated that students with disabilities should be integrated in a general education classroom regardless of their abilities to meet traditional curricular standards (p. 489). However, simply placing a student in a regular classroom will not result in academic success. This ineffectiveness of placing students in regular classroom was recognized by Biklen (1992), who argued against physical inclusion that is merely marked by students' presence in a general classroom where students are not required or expected to meet high standards. As a result, students with special needs are not fully participating in learning (p. 142).

Teacher's Attitudes towards Inclusion

Mandating and passing laws is necessary to support the full inclusion of students with special needs in general classrooms. However, laws by themselves may not have a positive effect in practice. Teachers and other professionals play a major role in the success of teaching students with special needs in general classrooms. This is supported by Hammond and Ingalls's (2003) study, which revealed that a majority of teachers who participated in inclusion programs reported "either negative attitude or uncertainty toward inclusionary programs" (p. 5). Such negative attitudes stemmed from teachers' uncertainty about the benefits that inclusion should provide. Furthermore, the teachers expressed the lack of collaboration among general and special educators and the lack of professional development (p.6).

In another study, mixed attitudes toward inclusion were reported after general education teachers had reviewed a videotape of a student with a disability. Even though

including disabled students is challenging, the experienced general and special education teachers concurred that placing students with mild disabilities in a general classroom for a few hours a day is beneficial. The mixed attitudes toward inclusion indicated that inclusion in theory is different from inclusion in practice (Taylor, Smiley, & Ramasamy, 2003, pp. 9, 10). Similar attitudes were reported by Idol (2006) and Lambert, Curran, Prigge, and Shorr (2005). Teachers were more favorable toward including students with mild disabilities but not with profound disabilities that cause disruptive environments (pp. 92, 93; p.7).

Campbell and Gilmore (2003) have examined pre-service teachers who reported being more comfortable with including students with disabilities in a general classroom after they learned about inclusion and had the field experience, in other words, after they had the opportunity to interact with students with disabilities (p. 376). These findings indicate that including students with special needs may be successful when pre-service teachers are taught inclusion, but most importantly are exposed to a field experience. Positive attitudes towards including students with disabilities in general education are also reported by Lambert and colleagues (2005) after pre-service teachers were required to take an introductory inclusion course (p. 9)

Changing the attitudes of experienced teachers, however, may be more challenging. Hodkinson (2005) reported that it is easier to understand the concept of inclusion than to employ it in an educational context (p. 23). Gaad (2004) believes that not only teachers but also society play an important role in implementing inclusion. To diminish the negative attitudes towards inclusion, Gaad recommended changing the

attitudes of society first, before changes are made in a policy or legislation. He also called for education of people about intellectual disabilities (p. 326).

Other Cultures' Views on Inclusion

Mixed attitudes about including students with special needs or students with disabilities are also reported in studies conducted in different cultures. For example, in a large city in Finland students with special needs are serviced in special schools. Therefore, segregation is in place instead of inclusion. This is due to organizational constraints of special education. Other cities (Helsinki, Imatra, and Turku) in this country differ in terms of practicing inclusion of students with special needs indicating that the cities implement inclusion at some degree (Kivirauma, Klemela, & Rinne, 2006, p. 129).

Lifshitz, Glaubman, and Issawi (2004) examined attitudes of Palestinian and Israeli teachers. They found that Israeli teachers were more willing to include students with special needs than Palestinian teachers. The students with special needs were visually impaired, hearing impaired, and mentally delayed. The negative results of the Palestinian teachers were influenced by their belief about the disabilities, i.e. those individuals who are disabled were punished by God. In addition, they were more conservative than the Israeli teachers (p. 184).

Similarly, Israeli pre-service teachers were more positive. They supported the philosophy of integrating students with disabilities with the notion that non-disabled students should also benefit in an inclusive teaching context. However, they had mixed feelings about general educators' instructional skills to teach diverse students with special

needs. Those concerns also included general teachers' ability in terms of management and behavior issues. In terms of demographics, Jewish students were more supportive of inclusion in comparison to Arab (Muslim) students (Romi, & Leyser, 2006, p. 97). These results are consistent with another study (Alghazo, Dodeen, & Algaryouti, 2003). The findings revealed negative attitudes of Arab pre-service teachers towards persons with disabilities regardless of the number of contact hours (p.6).

Another study was conducted in Mumbai, India. It examined multiple variables and their effect on teachers' attitudes towards disability and inclusive education. In doing so, teachers of the youngest group (20-30 years of age) and oldest group (50.1-60 years of age) reported most positive attitudes in comparison to age group of 40.1-50 years. Also, teachers of higher income expressed more positive attitudes than those of lower income. Another variable examined was years of teaching experience. The study shows that teachers with less experience (less than 5 years) and most experience (more than 25.1 years) reported most positive attitudes. In terms of education level, teachers who held a Master's degree in Education and Bachelor's degree in education reported more positive attitudes than those who held only a Diploma in Education. Gender had no effect on attitudes towards inclusion, however acquaintance with a person with disability was the major factor that positively affected teachers' attitudes (Parasuram, 2006, pp. 238, 239).

Also, positive attitudes toward including students with disabilities were reported by Korean general educators who received their support via weekly information and contact with special education teachers. The weekly information entailed "information about the student with disabilities, news from the special class, information on special education

and inclusion, and space for feedback from the integrated class teacher"(p.405). One needs to note however, that the students with disabilities were enrolled only part of the day with students without disabilities (Kim, Park, & Snell, 2005, p. 409).

Pre-service teachers of Northern Ireland reported generally positive attitudes toward inclusion regardless of identified challenges. However, a number of pre-service teachers expressed neutral feelings about inclusion and felt unqualified to make a definitive pro or against decision. In their definition of inclusion they recognized the need for integration of students with special needs and instructional adaptations. They have also voiced the importance of reduced class size for implementation and effectiveness of servicing students with special needs. They also addressed the importance of teacher training to promote positive attitudes and instructional skills that encompass inclusion of students with special needs in a regular classroom (Lambe & Bones, 2006, pp. 181, 182).

Parallel findings in terms of teacher training are reported in another study conducted in Northern Ireland (Winter, 2006). The pre-service teachers felt that their Initial Teacher Education program did not prepare them to teach students with special needs. They further stated that the number of years (one-year vs. four-years) they were enrolled in the program had no effect on improving their preparedness to teach students with special needs. The findings indicated the importance of providing a course about students with special needs and courses that educate regular teachers how to instruct students with special needs across subject areas (p. 89).

Parental Attitudes towards Inclusion

Parents are the major advocates of inclusion and they simply want what every parent wants for their children, i.e. to participate in community life, to participate in family life, to be wanted and accepted in regular schools and to have friends. In short, parents of children with disabilities want them to have "the chance to participate in everyday life" (Biklen, 1992, pp. 6-8). Parents of children who are disabled do not choose to have a child with a disability and yet many parents have become experts in including their child in their family life. They find this as an indicative that including students with disabilities in regular classrooms is possible as long as teachers consult with experts and have their support (Biklen, 1992, p. 14).

Crawford and Simonoff's (2003) study did not exclude parental involvement. In fact, parents reported that they valued professionals who would interact with them to better service their children. However, parental input is not always taken seriously or valued by professionals. Many parents reported that professionals had their own agenda which was not in line with parents' expectations (p. 484). In another study (Dunkan, 2003), parents viewed relationships with family and school as a warfare that entailed enemies and aggressive conflicts (p. 346). Biklen (1992) stated that parents were not viewed as a "potential resource but rather as people who place demands on them [schools and educators])" (pp. 63, 64). Furthermore, parents complained about bureaucratic procedures followed to service children with special needs. In doing so, parental knowledge was silenced in favor of professional knowledge (p. 64).

The finding about silencing of parents is at some variance with another research finding which demonstrate that parents do have a voice when it comes to provision of services for students with special needs. However, there are certain limits. In other words, parents were allowed to express their concerns, experiences, and demands. Doing so is respectful and possibly helpful for school officials who make the final decision about servicing students with special needs (Norwich, Griffiths, & Burden, 2005, p. 161).

Labeled Students and their Acceptance

Many parents expressed resentment towards labeling their children with a disability. They would appreciate people to view their child as an individual who has a name, possesses gifts, has interests, and is useful in society (Biklen, 1992, pp. 14, 15; Fitch, 2003, p. 239). Being a parent of a labeled child has a negative impact on one's emotions. Parents of children with an EBD (emotionally and behaviorally disturbed) label felt isolated, marginalized, and blamed for their child's condition (Crawford & Simonoff, 2003, pp. 483, 484).

Those negative experiences are in part attributed to the way society responded and responds to individuals with disabilities. In fact, society in the past portrayed individuals with disabilities as "clients" who should renounce their liberties and determination that individuals without disabilities exercise. As a result, parents are in a constant struggle to help their children fit in society. They also want society to accept their children regardless of their behavior or appearance caused by their disability. In doing so, parents would like schools to determine and identify ways to change or prevent unacceptable

behavior instead of just tolerating such behavior. In addition, they want their children to be active participants in daily lessons (Biklen, 1992, pp. 48, 49, 77, 78, 121).

Hodson, Baddeley, Laycock, and Williams (2005) have also reported the importance of social relations and suggested that schools should consider teaching students social skills (pp. 58, 65). This finding is parallel with Skarbrevik's (2005) study which reported that schools practicing the inclusion of students with special needs should develop educational programs that address and foster the development of social inclusion and friendships among students with and without special needs. Furthermore, Skarbrevik stressed that simple physical inclusion of students with special needs will not result in the development of social skills and friendships (p. 399). This assertion is supported by Smoot's (2004) data, in which only 43 % of the students with mild intellectual disabilities were named as a friend at least once by general education students (p.11).

Students' Perspectives towards Inclusion

Curtin and Clarke (2005) addressed the importance of communication among school officials and students with special needs to determine what accommodations they need to be successful in a general education setting. Such communication is imperative, for every student with disability/special needs requires different accommodations. In other words, students with special needs differ among themselves and their perspectives are important. These conclusions were based on findings that indicated varied perspectives towards segregated special schools and regular schools – that is, students who attended segregated special schools expressed positive experiences whereas students

in regular schools expressed both positive and negative experiences in terms of academics and social relations (pp. 208-211).

Pitt and Curtin (2004) reported similar views of students with special needs. The students voiced the importance of their input about their placement in general education or special schools, "all of the participants brought up the need for the choice" (p. 397). The need for choice may stem from the fact that some students may resist entering general education classrooms because they experienced embarrassment, prejudice, isolation and marginalization, whereas they portrayed special education as a safe place (Fitch, 2003, p. 241; Pitt & Curtin, 2004, p. 397). Others, however, found such experiences inevitable and essential for preparation to function in society (Pitt & Curtin, 2004, p. 397).

Kortering, deBettencourt, and Braziel (2005) examined students who reported that they preferred to be taught by caring teachers who create interesting and relevant teaching strategies. Furthermore, students pointed out the importance of reducing the complexity of algebraic problems and concepts. These findings indicate that students are able to voice their minds and as such they should have input in the development of their Individual Education Program (IEP) and thus help with the determination of instructional accommodations (p. 202). Kortering and colleagues concluded that students should take part in their "self-directed success." Such success is based on students' thoughts about improvement of their academic performance (p. 202).

Furthermore, students with special needs felt that teachers' beliefs and practices affect them socially and academically (Fitch, 2003, p. 249). George and Duquette (2006)

also reported that teachers play an important role in promoting interpersonal development and academic growth by setting high expectations and developing strategies geared towards the needs of the students. However, they reported other elements that interplay in successful inclusion – that is, the parental and familial system, the personal and peer systems, and as mentioned, the teacher-instructional system (p.10).

Teacher Burnout Due to Inclusion

The teacher-instructional system is important, however teachers' professional needs should be met as well, otherwise they may experience burnout. Talmor and colleagues (2005) reported that teachers' attitudes toward inclusion had a reciprocal effect on their burnout – that is, teachers who reported more positive attitudes towards inclusion, experienced more burnout. The teachers with positive attitude set high expectations for themselves that they were unable to meet; as a result they felt less fulfilled and more burnt out (p. 226). This experience of teacher burnout is in line with Billingsley's (2004) conclusion "For some special educators, multiple, interacting, work-related problems (e.g., role ambiguity, too much paperwork, too little support) create prolonged experiences of stress, which can lead to burnout and attrition" (p. 375). This finding is also consistent with another study that emphasizes assigning a smaller workload for teachers. Doing so will make the teachers feel more effective and confident with implementing inclusion (Burstein, Sears, Wilcoxen, Cabello, & Spagna, 2004, p. 113).

Further, teachers who experienced burnout reported more disciplinary problems in class, problems accommodating students with special needs and regular students due to

insufficient planning time, problems assessing students' work, and demands to contact parents on a regular basis. In addition, inclusive classrooms with a higher number of students with special needs and the lack of support/assistance have increased teacher burnout (Talmor, Reiter, & Feigin, 2005, p. 227). To decrease the incidents of burnout and make inclusion successful, Billingsley and Talmor and colleagues recommended a holistic or system approach. The system approach should also diminish a gap between teachers' instructional skills and the means provided for successful inclusion (p. 375; p. 227).

Teaching Strategies for Inclusive Biology

Role of Paraprofessionals

One form of support for regular biology teachers in implementing inclusion is hiring paraprofessionals. Paraprofessionals are "individuals who assist teachers and others in provision of services to students with disabilities" (Friend & Bursuck, 1999, p. 35). The positive assistance of paraprofessionals in regular classrooms was reported by parents in a study conducted by Gessler-Werts, Harris, Young-Tillery, and Roark (2004). These researchers reported that the majority of parents found paraprofessionals helpful in providing students with academic assistance. Furthermore, some (25%) of parents reported that paraprofessionals helped students remain focused and some others (21%) reported assistance in behavioral problems. In addition, many parents were positive about paraprofessionals' presence because they provided extra help to students and made inclusion possible (p. 235). Giancreco and Broer (2005) reported substantial reliance on paraprofessionals. However, data also indicated that individual paraprofessionals spend

less time instructing students with disabilities and spend nearly a quarter of their time performing activities that may not relate to lesson planning (Giangreco & Broer, 2005, pp. 21, 23).

In Gessler-Werts and colleagues' (2004) study, parents stated that paraprofessionals knew their child's academic/social strengths and weaknesses and thus should be included in instructional planning, preparing for individual instruction, should attend and have input in establishing Individualized Education Program (IEP) (p. 237). Most paraprofessionals in another study (Giangreco & Broer, 2005, p. 23) were provided the IEP goals. This means they did not play a role in establishing the IEP but were supposed to follow it. This indicates the need for better communication and collaboration among educators (general, special needs and paraprofessionals). Doing so will improve paraprofessionals' skills and confidence, which in turn will benefit the students and their general education teachers as in line with Boyer and Mainzer (2003, p. 10).

Co-Teaching

The need for better communication and collaboration, necessary to implement inclusion practice in regular biology, is also reported in studies that examined co-teaching strategy (Weiss, 2004; Magiera & Zigmond, 2005). Weiss reported that co-teaching is practiced in many schools that provide services for students with special needs. However, Weiss questioned the meaning of co-teaching in terms of teaching responsibilities and concluded that "co-teaching generally means the presence of two teachers in one classroom" (p. 220). Magiera and Zigmond, who stated that teaching instruction was the same when one teacher conducted a lesson or two teachers conducted

the lesson, reported a similar finding. Such inert teaching practice stems from failure of preparing teachers to engage in co-teaching relationships and failure of common planning (p. 84).

Mastropieri, Scruggs, Graetz, Norland, Gardizi, and McDuffie (2005) shed some light on the reasons for the indifferent delivery practices in a co-teaching context. One of the reasons relates to teachers' knowledge of academic content. Mastropieri and colleagues reported that when the content was more challenging and not easily assimilated by the special education teacher then the general education teacher took on the leading role in delivering instruction for the entire class while the special education teacher took the role of an assistant (p. 268).

Wischnowski, Salmon, and Eaton (2004) reported similar findings where the general educator took on the lead role while the special educator circulated around the classroom to assist students who required help (p.6). Friend and Bursuck (1999) called this co-teaching approach "one teach, one support" and emphasized that this approach should not be the only one implemented. The lack of alternating teaching roles in general biology classrooms may result in feelings of being incompetent or not legitimate (p. 83). This is at variance with research findings that demonstrated special educators' relief when they did not have to prepare to teach challenging/unfamiliar content. In other words, special educators were more comfortable in providing assistance to students instead of preparing to teach unfamiliar material. On the other hand, when the special education teacher easily assimilated the content, then both of the teachers took on the teaching responsibilities equally (Mastropieri et. al., 2005, p. 266).

High-stakes testing influenced another reason for the diminished delivery instruction by special educators. In fact, high-stakes testing "exerted a strong influence on how content was covered and how co-teachers collaborated" (Mastropieri et. al., 2005, p. 268). As a result, general educators were determined to teach all of the content within the limited time specified in content guidelines without considering more effective teaching strategies. Such fast-paced instruction did not even provide an opportunity for special educators to modify content or to prepare for delivery instruction (p. 268).

Co-teacher compatibility was another detrimental factor in successful inclusion. Teachers who shared a mutual trust and respected each other's professionalism were more successful in providing services to the entire class where inclusion was implemented than teachers who experienced a conflicting relationship. The co-teaching success also depends on teachers' content knowledge and their beliefs about "how to plan for co-teaching, how to manage behavior, and how to interact with students" (Mastropieri, 2005, p. 269). This finding is consistent with Devlin's (2005) study, which reported factors that influence collaboration among educational team members such as "prior knowledge, communication and group interaction skills, logistical issues (e.g., lack of planning, time), attitude, and administrative leadership all played a part in each team's ability and effectiveness in planning for ongoing student support in the general education setting" (p. 55). Years of teaching experience, however, did not affect co-teaching practices (Mastropieri, 2005, p. 269).

Furthermore, improvement of teamwork between special educator and regular teacher resulted in improved goal attainment in addition to the established IEP

(Individual Education Plan) for students with special needs. The goals were measurable and related to the teachers' actions, data collected, followed by team reflection that was modeled to the teachers (Devlin, 2005, pp. 56, 57). Hollins and Oliver (1999) emphasized the importance of reflective teaching, explaining that a teacher who is a reflective practitioner should be able to recognize that not all of the students comprehend concepts taught in the same manner. In doing so, the teacher should be able to change the teaching style/strategies that accommodate the majority of the student population. In other words, a reflective practitioner is flexible in adopting or implementing new strategies to accommodate the students' learning (pp. 13, 14). Similarly, Sobel and Taylor (2006) believed that responsive teaching is important and should be implemented when educating students (p. 29).

Accommodations

Accommodations are adaptations that teachers implement in delivery instruction, teaching materials, student activities, and assessment. The purpose of adaptations is to "increase the likelihood of success for students with special needs" (p. 296). However, those adaptations should not interfere with teaching students without special needs; instead they may be helpful to all students in the classroom (Friend & Bursuck, 1999, p. 296). In one of the studies a school district implemented accommodations that included providing "visual cues (e.g. agendas, the use of colored markers to compare and contrast, graphic organizers), auditory cues (e.g., volume and inflection changes in voice, timers, mnemonics), and tactile cues (e.g., "touching" words, manipulatives, proximity for emphasis)" Wischnowski, Salmon, Eaton, 2004, pp. 7, 8). These accommodations were

effective in improving student achievement. Moreover, they addressed not only students with disabilities but also other students who learn in different ways – that is, have different learning styles (Wischnowski et. al., 2004, p. 7).

Similarly, Maccini and Gagnon (2006) reported the use of instructional accommodations "color coding, peer or cross-age tutoring, and calculators," extended time on assignments, and the reading of problems to students. Assessment accommodations included reduced number of test questions, use of cue cards, use of concrete objects, and reading problems to students. However, the findings revealed that special education teachers were more likely to implement these accommodations in comparison to general educators (p. 230).

Implementation of Technologies

Implementation of technology-based graphic organizers proved effective in inclusive social studies classrooms. In their study, Boon, Burke, Fore, and Hagan-Burke (2006) employed Inspiration 6 software that resulted in improved content learning when compared to traditional textbook instruction (p. 10). On the other hand, Riley and Ahlberg (2004) implemented an information and communication technologies (ICT)-based concept-mapping program that was used to produce different graphic organizers and they also promoted learning (p. 253). Support for the use of technologies in an inclusive classroom is also voiced by Swartz, Balkin, and Phillips (2003) who found computer integration in classroom instruction as effective for both higher and lower level students (pp. 53, 55). This is in line with Weikle and Hafadian (2004), who found implementation of technologies effective for students with and without special needs (p.

183). In contrast, Kroesbergen and Van Luit (2003) concluded that computer-assisted instruction does not replace the direct instruction provided by the teacher or self-instruction. Thus, they found computer-assisted instruction less effective (p. 111).

Volitional Control

Volitional control is a strategy that teaches students how to self-regulate their emotions and improve their motivation to learn. This strategy may be employed by biology teachers and other general educators who implement inclusion in their classroom (Mccann & Turner, 2004, p. 1702). Similarly, Sideridis (2005) and Simons, Dewitte, and Lens (2004) are also proponents for the employment of the volitional control strategy. Simons and colleagues reported that internally regulated students are more on task, more excited and motivated to learn, and overall are more successful academically (p. 356).

Pellitteri, Dealy, Fasano, and Kugler (2006) have emphasized the importance of self-regulation in students with learning disabilities. Those who do not self-regulate learning and emotions tend to be passive and dependent learners who lack motivation to learn (p. 157). The self-regulation involves one's ability to regulate emotions, thus Pellitteri and colleagues recommended teachers develop emotional intelligence interventions that involve "creating positive emotions within school ecology, the classroom, and the peer groups" (p. 168). By doing so, teachers will improve students' motivation to learn, social relations, information processing, and cognitive organization (p. 168). Chung and Chow have also concluded that students who self-regulate their learning process tend to be more motivated to learn and achieve (p. 167).

Another study (Wehmeyer, Yeager, Bolding, Agran, & Hughes, 2003) revealed consistent results that support effectiveness of self-regulation strategies. Data revealed that students with developmental disabilities showed consistent improvement in attentiveness, on-task behaviors, and appropriate listening skills. In fact, the strategies exceeded teachers' expectations for goal attainment in students' behavior that in turn positively affected their progress in general curriculum (pp. 89, 90). Furthermore, the researchers claim that the use of self-regulation skills enables students with developmental disabilities and mental retardation to help control their learning and self-determination (p. 90).

The self-regulatory aspects of learning among students with and without disabilities were examined by Ruban, McCoach, McGuire, and Reis (2003). The results indicated that self-regulation improved academic achievement in students with learning disabilities but not in students without learning disabilities. It is interesting to note that students with learning disabilities did not find the use of conceptual skills (as a metacognitive self-regulation) as beneficial even though their academic achievement improved. This is indicates that students need the teacher's assistance/feedback in determining strategies that suit their learning needs (pp. 281, 282).

Harris, Danoff Friedlander, Saddler, Frizzelle, and Graham (2005) conducted a study that relates to the self-regulation strategy. They examined self-monitoring of attention and self-monitoring of academic performance strategies on students with attention deficit and hyperactivity disorder. The aim of the study was to improve students' spelling study behavior in the general education classroom. Both of the

strategies resulted in positive outcomes, however, students who used the self-monitoring of attention strategy demonstrated better spelling study behaviors (p. 154).

Embedded Instruction

During embedded instruction the teacher controls instructional delivery and implements specific teaching procedures – that is, provides stimuli to teach target skills. As such, the teacher would provide a stimulus and model a correct response immediately or after a 3 or 4 second delay. For example, the teacher would ask a student, "How many chromosomes do human diploid cells contain?" following with an immediate correct response, or after 3seconds/4seconds, "23 chromosomes" (Johnson, McDonnell, Holzwarth, & Hunter, 2004, p. 219). Polychronis, McDonnell, Johnson, Riesen, and Jameson (2004) implemented embedded instruction in their study within 30 minute and 120 minute instruction and concluded that this strategy "holds a promise as a strategy for practitioners who are supporting students with developmental disabilities in general education classes" (p. 149). However, students mastered more target skills within the 30-minute instruction when compared to the 120-minute instruction. Furthermore, general teachers expressed their positive views of implementing this strategy because it did not interfere with teaching other students (Polychronis, et. al., p. 147). Similarly, an earlier study (Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003) confirmed the effectiveness of embedded instruction. This instruction was favored even more because it involved employment of typical materials used by general education students and thus teachers did not have to develop special materials to accommodate students with special needs (p. 257).

The embedded instruction described above was implemented on younger children of elementary age. The reason for examining younger students is explained by Conroy, Dunlap, Clarke, and Alter (2005) who stated, "we should increase our emphasis on younger children prior to the development of chronic behaviors that may influence their later success in school" (p. 165). In light of this, Stichter, Sasso, and Jolivette (2004) employed a structural analysis procedure to identify variables that promote positive social behavior for elementary age students with emotional/behavioral disorder. They concluded that high structure instruction is "a pivotal variable in promoting low levels of problem behavior in a general education setting as well" (p. 175). Furthermore, the improved behavior positively affected the student's academic performance. This finding confirms Conroy and colleagues' assertions.

Cooperative Learning

Cooperative learning involves formation of small groups where students work together to accomplish shared goals. In such a learning environment competition is eliminated and mutual support and effort is practiced (Johnson , Johnson, & Holubec 2002, p. 5). To accomplish shared goals Johnson and colleagues (2002) developed five elements that create cooperative learning: positive interdependence, individual/group accountability, positive interaction, appropriate use of social skills, and group processing.

Positive interdependence is one of the most important elements of cooperative learning. It requires each individual in a group to realize that their success depends on each other. In other words, every member of a group must contribute to the success of the whole group. Without this element cooperative learning simply will not exist.

The second element for structuring cooperative learning is accountability at the individual and group level. The group accountability involves groups' understanding of what needs to be done, i.e. the goals are clearly stated and they are measurable. Ability to measure the goals indicates progress of the entire group and each of its members. Individual accountability involves assessment of individual work that is returned to the group. Doing so will allow the group to discover which member of the group needs further assistance or encouragement.

The third element of cooperative learning is positive interaction, which is characterized by sharing of resources, support, encouragement and praise of each other's work and efforts. These interactions are part of the academic support system that involves helping each other to learn (thus every person has someone committed to him or her learning) and a personal support system that involves one's commitment to a person. Doing so will promote each other's learning, commitment to each other and commitment to the group.

The fourth element essential to cooperative learning involves appropriate use of social skills that are necessary for task accomplishment and teamwork to do so. The team members need to be taught such skills to develop high quality cooperation. Cooperation involves leadership abilities, ability to make decisions, trust development, communication skills development, and problem solving ability, i.e. conflict management skills.

The last element, group processing, calls for discussion among group members that addresses achievement of their goals and their positive working relationships. In so

doing, members should discuss what strategies in their group work and what should be improved for the group to achieve their learning goals. Group processing is a process that involves continuous analysis of working relationships among the members of the group and group effectiveness (Johnson et. al., 2002, pp.8-10).

Peer-Assisted Learning Strategies

Peer-Assisted Learning Strategies (PALS) are designed to help students of various abilities in improving their reading and math skills. PALS implementation involves pairing students who are academically stronger with those who are academically weaker. To do this, the teacher ranks all the students according to their reading competence from strongest to the weakest and divides the ranking list in half. A student of the highest rank, from the first half of the ranking list, is paired with a student at the top of the bottom half of the ranking list and so on until all students are paired. Each student in a pair takes on the role of a tutor and a tutee for the same amount of time. The reading activities begin with reading material at the lower reader's level. Thus, pairs should read from different reading materials to accommodate their reading levels. Also for motivational purposes, pairs were assigned to one of two teams and during the reading activity each member of the pair was rewarded with points for positive tutoring behavior and provision of correct and immediate feedback (Fuchs, Fuchs, & Burish, 2000, p. 86).

Morgan, Young, and Fuchs (2006) reported that PALS at pre-school, kindergarten, and first grade level have motivated students to engage in developing reading comprehension skills (p. 39). Another study PALS developed for grades 2-6 indicated positive outcomes as well in terms of reading comprehension, fluency, and

accuracy. Furthermore, another part of this same study involved modification of the standard PALS. This time, instead of being provided with the immediate correct response the students were taught techniques that promoted tutees to provide the proper response on their own. The results indicated that the modified PALS outperformed the standard PALS in terms of reading progress (Fuchs, Fuchs, & Burish, 2000, p. 89). Fuchs, Fuchs, and Burish (2000) have also evaluated PALS at a high school level in remedial and special education classes. They concluded that students improved in reading comprehension but not in reading fluency (p. 90). PALS was also implemented to determine the social standing of students with learning disabilities for grades 2-6. Findings indicated that students with learning disabilities were thus more socially accepted than those who were not exposed to PALS. Also, students with learning disabilities experienced the same social standing as students without learning disabilities (Fuchs, Fuchs, Mathes, & Martinez, 2002, pp. 211-212). Students with disabilities at a high school level who participated in PALS and CBM (curriculum-based measurement) implemented in mathematics class demonstrated improvement in math computation skills. However, they did not improve in development of concepts and applications skills. These findings are supported by the revised version of Math Operations Test, Math Concepts and Applications Test, and Tennessee Comprehensive Achievement Test (Calhoon & Fuchs, 2003, p. 242).

Literature Related to Methods

The aim of a grounded theory is to "generate or discover a theory" about phenomenon that results from interactions of individuals, their actions, and engagement

in the phenomenon (Creswell, 1998, p. 56). Bruce (2007) stated, "grounded theory studies are 'grounded' in the data collected to develop or refine models of understanding through an inductive process" (p. 10). In this line, Glaser (1992) stated that grounded theory "(1) is grounded systematically in the data and (2) it is neither forced nor verified (concepts which relate to no data)" (p.15). Furthermore, he stated that the theory must have four characteristics: "fit, work, relevance, and modifiability". Thus, the theory is generated based on the categories and properties that fit the realities of the phenomenon. Grounded theory that works refers to its ability to explain a variety of behaviors that are in agreement with the subjects. Once fit and work is achieved then the theory becomes relevant. Once it is relevant, however, it should be modifiable when new data emerge and thus lead to different properties and categories (p.15). This is what Giske and Artinian (2007) performed in their study. They allowed the main problems and processes experienced by participants to emerge and fit the concepts with data to understand phenomenon studied (p. 78). To enhance rigor of grounded theory study Chiovitti and Piran (2003) developed eight methods of research practice: (1) let participants guide the inquiry process; (2) check the theoretical construction generated against participants' meanings of the phenomenon; (3) use participants' actual words in the theory; (4) articulate the researcher's personal views and insights about the phenomenon explored; (5) specify the criteria built into the researcher's thinking; (6) specify how and why participants in the study were selected; (7) delineate the scope of the research; and (8) describe how the literature relates to each category which emerged in the theory (pp. 430-433).

A grounded theory study found in the literature was conducted by Hodkinson (2005) to examine future teachers' conceptions and misconceptions of inclusive education and found that the teachers understood the complexity of inclusive education. Furthermore, the teachers found inclusion to be beneficial to children in terms of equity and fairness, however they lacked the understanding of how inclusion should be implemented in a classroom. The researcher employed a questionnaire that consisted of three open ended questions. The data were analyzed using the techniques recommended for a grounded theory study (Glaser & Strauss, 1967/2006) and by simple statistical methods. This study deals with teachers' conceptions and misconceptions of inclusive education that relates to the current study. However, the literature does not focus on teaching strategies that biology high school teachers use to instruct students with and without special needs.

Differing Methodologies Related to This Study

Other studies, utilizing different methodologies than grounded theory study, were found in the literature that informed the current study. The types of studies found in the literature included descriptive qualitative study, descriptive quantitative study, multiple base-line study, quasi-experimental study, case study, phenomenology study, ethnography study, and biography study.

The descriptive qualitative studies found in the literature deal with implementation of a change model that promotes inclusive practices and parental views about paraprofessionals. For example, Burstein, Sears, Wilcoxen, Cabello, and Spagna (2004) describe implementation of a change model based on inclusion reform that

involved the California Department of Education, institutions of higher learning, and selected school districts. In order to document the impact of the model on students with disabilities the researchers conducted individual and focus group interviews that were audiotaped and transcribed. The data were categorized into broader areas and then coded. Also, emerging themes were recorded and a second level of analysis was conducted. The data revealed that all schools implemented inclusive practices, however the inclusive approaches differed among the schools, resulting in provision of different services to students with special needs. Similarly, Gessler-Werts, Harris, Young-Tillery, and Roark (2004) presented descriptive qualitative study, however they addressed parental views about paraprofessionals. In so doing, the researchers observed the students and paraprofessionals in inclusive classrooms and conducted interviews with students' parents. The interviews were conducted in person and by telephone. The interviews were transcribed and coded. The results indicated that parents held positive perceptions of the paraprofessionals who worked and interacted with their children. However, they offered several recommendations to improve inclusion implementation in classrooms such as provision of more training for paraprofessionals, better communication between parents and school staff, and paraprofessionals' active input at Individualized Education Program meetings.

Giangreco and Broer (2005) conducted a descriptive quantitative study that addressed how paraprofessionals were utilized in inclusive schools. The researchers gathered data from participants (general education teachers, special education paraprofessionals, parents, special educators, and school administrators) who responded

to structured questionnaires. The data were analyzed using SAS Institute, Inc., one-way ANOVA, Scheffe post hoc, t tests, and Chi-square analyses. The findings revealed that, on average, special education paraprofessionals spent a substantial amount of time providing instruction to students with special needs when compared to special educators and general education teachers.

Harris, Danoff Friedlander, Saddler, Frizzelle, and Graham (2005) conducted a multiple-baseline study. However, the aim of this study was to determine differential effects of self-monitoring of attention (SMA) and self-monitoring of performance (SMP) on the on-task and spelling study behavior of students with ADHD in general education classrooms. The on-task behavior and academic performance data were presented for baseline, SMA, and SMP interventions and then compared. The study found that both SMA and SMP had a positive effect on students' on-task behavior when compared to the baseline data. Similarly, SMP and SMA had a positive effect on academic performance. After the treatments (SMA and SMP) were implemented students completed an exit interview and reported preference of the SMP condition.

Boon, Burke, Fore III, and Hagan-Burke (2006) conducted a quasi-experimental study to examine the effects of graphic organizers on improving student content knowledge in inclusive social studies classrooms. This study is a replication of a previous study in an attempt to strengthen and extend the previous findings. In this regard, the study involved two inclusive classrooms containing students with and without special needs. The students were placed in an experimental group, exposed to cognitive organizer condition, and a control group, exposed to the traditional textbook instruction.

Both groups used the same chapter to learn new information and both groups were administered the same pre- and post-test. The data were analyzed with the use of SPSS, ANOVAs, eta squared, and Cohen's d. The study found that the students who were taught with the cognitive graphic organizers outperformed those who used the traditional textbook method. In addition, data revealed that students with and without special needs scored higher when exposed to the graphic organizers.

Mastropieri, Scruggs, Graetz, Norland, Gardizi, and McDuffie (2005) present case studies examining co-teaching within upper elementary, middle, and two secondary content-area classes (earth science, social studies, world history, and chemistry respectively). The aim of these studies was to implement and examine co-teaching practices in different settings and content areas. Throughout these studies the researchers interviewed both general and special education teachers and their students (with and without special needs). In addition, the researchers videotaped classes, took field notes, observed class activities, and examined student-generated artifacts. The data were analyzed according to the qualitative and inductive approaches. The studies revealed that the level of content knowledge a teacher had determined who the dominant teacher would be. Thus, when a special needs teacher lacked the knowledge in certain content then that teacher would take on the role of an aide. Furthermore, teachers' teaching practices were influenced by high-stakes testing, and as such teachers felt that covering all of the material for the test is more important than how the material is taught. This resulted in diminished special education teachers' roles in the co-teaching environment. Co-teacher compatibility was another variable relevant in co-teaching. Teachers who got along and

shared perspectives on effective teaching were more successful in an inclusive environment than those who experienced conflicts.

Moreover, additional literature regarding differing methodologies was reviewed to guide the researcher to determine the most appropriate research approach for this dissertation. According to Creswell (1998) for example, a case study is used to explore a bounded system (bounded by time and place) or a case (or multiple cases) over time (p. 61). Miles and Huberman (1984) define a case as "a bounded context in which one is studying events, processes, and outcomes" (p. 28). As such Jones and Lyons (2004) find case study useful for it has a potential in exploring different dimensions of any particular case or multiple cases (p. 3). This exploration may be challenging to the researcher because each single case explored in a single social setting may result in subsequent sub-settings that add to the complexity of data collection and analysis (Miles and Huberman, 1994, p. 27). In other words, the researcher may be challenged in deciding which cases to study since several of them may surface and still be worthwhile examining. Luck, Jackson, and Usher (2005) argue that case study is a research tool that can be used in qualitative as well as quantitative paradigms. They call case study "a bridge across the paradigms" (p. 108). Similarly, Bitekhtine (2005) argues that deductive theory (associated with quantitative paradigm) can be tested using qualitative research methods such as case study design (p. 5). Stake (2000) opposes such assertions, stating that "case study is not a methodological choice but a choice of what is to be studied" (p. 435). In fact he explains that different methods may be used to study individual cases.

Literature in regards to ethnography approach was also examined. Trochim (2001) emphasized that ethnography involves studying of a culture not limited to ethnicity and geographic location but also extended to a business or a defined group (p. 159). Similarly, Creswell (1998) defined ethnography as a "description and interpretation of a cultural or social group or system" (58). Tedlock (2000) stated that the descriptions of culture may be influenced by the researcher's biography and experience and as such should be included in the study (p. 471). Roberts and Sanders (2005) also address researcher's biography, however they emphasize the neglect of broader structural mechanisms in ethnographic research. These mechanisms include "problems of gaining research money to analyzing structural modes of regulating a research context [and] historical processes that have structured a research context, thereby giving it a unique ideological identity" (p. 310).

Another approach considered but rejected is biography. In this approach the researcher examines life experiences of a single individual (Creswell, 1998, p. 47). Robson (2002) calls this approach "a particular kind of case study where the 'case' studied is an individual person" (p. 195). Furthermore, Robson stated that this approach is less likely chosen by a researcher due to the need of extended time to develop a rigorous study, which is less likely to be funded because the research questions are less likely to address the problems of the funder's interest (p. 195). In spite of this, Dhunpath (2000) believes that studying such a small sample will allow emergence of narrative that is rich in depth. In other words, a bibliography approach is "dedicated to celebrating the voices of the silenced. But more than that, it celebrates biography as an authentic

reflection of the human spirit, a mirror to reflect *visions of our other selves"* (p. 550). In this line Stroobants (2005) believes that this approach allows the individual (participant) to tell a story about himself/herself that is taken for granted but acknowledged by the researcher (p. 57).

These studies inform the current research by discussing the implementation of a change model and parental views about paraprofessionals, the roles of paraprofessionals in inclusive classrooms, teachers' beliefs about inclusion theory and its implementation, and teaching strategies (co-teaching, graphic organizers, SMA and SMP) used in inclusive classrooms. In so doing, different methodology approaches (descriptive qualitative study, descriptive quantitative study, multiple base-line study, quasi-experimental study, and a case study) were used but rejected for use in the current study because their use will not properly address the specific research questions presented in this study. Similarly, more literature pertaining to the usefulness of case study, phenomenology, ethnography, and biography was reviewed, considered, but rejected due to their lack of properly addressing the specific research questions.

Summary and Conclusion

The need for provision of high quality instruction in science is recognized and supported by No Child Left Behind Act (2001), National Science Education Standards (1996), and Project 2061 (AAAS, 1998). These national education reforms support science education of all students, students with and without special needs. Education of students with special needs is further protected by Public Law 94-142, Public Law 101-476, and Public Law 101-336 and as such resulted in full inclusion of students with

special needs in regular classrooms (Chiappetta, 1998). Thus, the students with special needs are required to be taught in regular classrooms to the greatest extent possible. However, teaching students of different academic proficiency levels in the same classroom is a difficult task and is affected by teachers', parents', and students with special needs' attitudes towards inclusion. In this light, studies revealed teachers' and pre-service teachers' mixed attitudes towards inclusion. Teachers mostly supported inclusion theory, but found its implementation to be difficult and time-consuming. Similarly, parents found inclusion important and valuable to their children's education but also challenging in terms of bureaucratic procedures they had to follow to provide services for their children. Furthermore, studies examined students with special needs' attitudes and perspectives towards inclusion that stem from their experiences in general classrooms. The results revealed that the students expressed positive and negative attitudes towards inclusion in terms of academics and social relations (Curtin & Clarke, 2005). Other studies, as discussed in the literature review, examined students' feedback about instructional strategies teachers used and other factors that may affect their learning such as teachers' beliefs and practices. However, the number of studies in these areas is limited and thus additional research is required.

Determining and identifying teachers', parents', and students' attitudes towards inclusion is relevant but not sufficient when it comes to acquiring an understanding of how students with special needs should be taught high school biology in a general classroom. In fact, there is a vast amount of research that examined teaching strategies that may be applicable in teaching special needs students, such as cooperative learning,

inquiry based instruction, and co-teaching among many others as described in the review of literature. However, none of the strategies have explicitly examined the teaching strategies that high school biology teachers should employ to instruct students with special needs.

The purpose of this grounded theory study was to understand high school biology teachers' perspectives, practices, and challenges in relation to teaching students with special needs. A substantive model was developed for high school biology teachers who are challenged with teaching students with and without special needs. The model may help teachers improve their instructional practices. Thus, the study filled a gap in the related research, providing useful information to high school biology teachers who implement inclusion in their teaching practice and to other science teachers, high school administrators, and other researchers. In chapter 3, a detailed explanation is provided of the research design and methodology that was used to fulfill this stated purpose.

Chapter 3: Research Method

Introduction

Meeting the needs of all students in the regular classroom is a major concern in education. This concern is reflected in the No Child Left Behind Act (2001), Project 2061 (AAAS, 1998) and the National Science Education Standards (1996). These national educational reforms place continuously higher learning demands on students with and without special needs. There are more than six million school age individuals with disabilities who are taught in general education classrooms (Data Accountability Center, n. d.). Students with special needs as well as students without special needs have difficulties in learning biology in a regular classroom, as reflected by the American Association for the Advancement of Science (1998) and the National Assessment of Educational Progress (2005). Subsequently, high school biology teachers are challenged to instruct students of varied abilities and special needs. To address these concerns, this grounded theory study aimed to understand high school biology teachers' perspectives, practices, and challenges in relation to teaching students with special needs. A substantive model was developed for high school biology teachers who are challenged with teaching students with and without special needs. The model may help teachers improve their instructional practices. In this chapter, justification for the design choice is provided along with a detailed description of planned approaches for data collection and analysis.

Choices of Research Paradigm

The choice of paradigm for this study is the qualitative method, and the specific research design is a grounded theory study. According to Creswell (1998) and Hatch (2002), qualitative research relies on objects, holistic pictures, word analysis, and detailed descriptions of participants' views that are used to understand phenomena in a natural setting. To obtain such non-numerical data, Johnson and Christensen (2004) call for the use of: "a wide- and deep- angle lens" (p. 33) that allows the researcher to examine participants' behavior in depth and across different dimensions without manipulating the natural setting. Merriam (2002) states that qualitative research involves individuals who interact with their surroundings and construct their own meaning of how the world/reality works. The constructed meaning, however, cannot be measured mathematically because it is based on an individual's understanding of reality that in turn is open to different interpretations. Thus, the researcher who conducts a qualitative study will learn about individual's perceptions of the social world. The perceptions are constructed based on individual's interactions with his or her environment (p. 4).

In this study I explored high school biology teachers' perspectives of how the reality of teaching students with and without special needs is constructed. This undertaking allowed me to understand the teachers' perspectives, practices, and challenges they face in inclusive high school biology. To convey what is learned about this phenomenon I used rich descriptions of varying themes that emerged from the data. In so doing, this study fits the qualitative paradigm as opposed to quantitative paradigm that involves collection of numerical data where only one or a few isolated, incomplete

and disconnected factors are examined at the same time and under controlled conditions (Hatch, 2002, p. 9; Johnson & Christensen, 2004, p. 32).

Research Design

The aim of grounded theory research is to generate a theory that is grounded in the data that relate to a particular phenomenon evident in actions, interactions, and reactions among individuals (Creswell, 1998, p. 56; Trochim, 2001, p. 160). This approach was developed by Glaser and Strauss (1967), who simply stated that it is a theory based on data. Furthermore, they stated that grounded theory provides "relevant predictions, explanations, interpretations, and applications" (p. 1). This definition was expanded in other work of Strauss and Corbin's (1990) as:

> One that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systemic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis, and theory stand in reciprocal relationship with each other. (23)

There are two types of grounded theories – formal and substantive - and both are grounded in the collected data. A formal theory "emerges from a study of a phenomenon examined under many different types of situations" (Strauss & Corbin, 1990, 174). Such a theory must be applicable to a variety of different situations. On the other hand, the substantive theory is not widely applied. Instead, the theory emerges "from the study of a phenomenon situated in one particular situational context" (Strauss & Corbin, 1990, p. 174). A substantive level theory is best suited for this study since the data were situated in a single context – that is, in high school biology classrooms where teachers instruct students with and without special needs. Creswell (1998) acknowledges that theory is

often depicted in a visual model, which is the intent of this study (p. 66). A model was developed that represents high school biology teachers' perspectives, the obstacles/challenges teachers face, and strategies they use when instructing students with and without special needs in the same classroom.

An additional requirement for the development of the grounded theory is researcher's creativity to develop new categories. Strauss and Corbin (1990) find creativity as a "vital component of the grounded theory method" (p. 27). They claim that using the grounded theory method forces the researcher to think critically and freely without previous assumptions or associations. This was done when I continued to refine the model that was based on the pilot study.

The grounded theory study employs the constant comparative method to analyze data. This method involves the examination of data to form categories that must be reexamined as new data are collected. This method is accomplished by following procedures involving open coding, axial coding, and selective coding which are described further in the data analysis section.

Other qualitative approaches were considered for this study but were dismissed. For example, a biography approach was considered but rejected since it involves examining life experiences of a single individual. Also rejected was the phenomenological approach, which involves examining and capturing the essence of lived experiences of several individuals. Ethnography, which involves examining of a cultural/social group, was also rejected, as the approach did not pertain to this study. A case study, involving an exploration of a bounded case or cases over time (Merriam,

2002, p. 178), was considered but rejected since participants in this study do not exhibit a bound system. The participants were interviewed at different times, different places, and in different communities.

Research Questions

This descriptive qualitative study addressed the following questions:

1. What are high school teachers' perspectives on how students with special needs learn biology?
2. What obstacles/challenges do biology teachers face in instructing students with special needs?
3. What strategies do high school biology teachers use to teach students with special needs?

Role of the Researcher

In this study I took on the role of an observer-as-participant. As such, I spent a limited amount of time interacting with participants, but informed them that I would be studying them (Johnson & Johnson, 2004, p. 190). I am qualified to take on this role because I have been teaching high school biology for ten years and I have struggled to instruct students with and without special needs in the same context. In doing so, I asked other high school biology teachers to participate in the phone interviews in order to develop a model that depicts their perspectives, challenges, and practices on how students with special needs learn biology. Simultaneously, I took on the role as the primary instrument since I collected and analyzed the data. Merriam (2002) calls the researcher the human instrument because humans have the ability to respond immediately, adapt to

different situations, and even understand nonverbal communication. Thus they are the ideal means for collecting and analyzing complex data (p. 5). However, such a role has a potential for bias on the part of the researcher that may have an impact on the outcome of the study. Therefore, it is important to identify and monitor the biases by acknowledging the researcher's subjective experiences and values (Auerbach & Silverstein, 2003, p. 27; & Hatch, 2002, p. 10). To do this I kept field notes and wrote memos.

Setting

The context of this study is a large public school district in the Midwestern United States. The school district comprises 478 elementary schools and 122 high schools. The researcher is employed in one of the high schools. The total student population in this district is over 350,000 and the total teacher population is over 22,000. The average teaching experience in this district is 13.2 years. Bachelor's degrees are held by 45 % of the teachers and 54.8 % of teachers hold master's degrees and above. Also, there are 2.1 % of teachers with emergency and provisional credentials and 23.5 % of teachers who are not highly qualified to teach their assigned subject areas. The district demonstrates a student population of predominantly low-income status with the following demographics: 8.3 % Caucasian, 46.9 % Black, 38.9 % Hispanic, 3.3 % Asian/Pacific Islander, 0.1 % Native American, and 2.4 % Multiracial/Ethnic. The overall high school graduation rate in the district is 66 %.

Participant Selection

A voluntary sample within a certain set of criteria formed the basis of the participant selection strategy. I developed the following inclusion criteria to select

participants: the participants must be high school biology teachers who instruct students with and without special needs. With the support of a PhD science specialist within the public school system, I recruited participants via listserv and email. This approach was supported by the school system. Of those responding, 15 were selected across responding schools. More were contacted (40) in order to reach saturation. Of the 40 contacted teachers, around 15 were expected to respond. Once the potential participants were identified via email, I obtained the person's telephone number and followed with the emailed letter of consent to participants that explained the purpose of the study, my role as the researcher, and the expected role of the participants. In addition, the interview questionnaire was formed prior to the phone interview and emailed to the participants. Sending out interview questionnaires in advance ensured that all research questions were addressed and helped to prepare participants to provide rich and detailed data.

Measures for Ethical Protection of Participants

Ethical protection measures of the research participants were taken during this study. First, before this study was conducted, I obtained approval from Walden's Institutional Review Board (approval number 04-23-09-0234722) and from my school district. This approval ensured the research participants' protection from any harm. Second, participation in this study was strictly voluntary and participants' confidentiality and anonymity was protected. According to Hatch's (2002) recommendation, I took the following steps to be sensitive to participants' vulnerability: I provided participants with a full disclosure of research intentions and informed them that their participation is voluntary (p. 67).

Finally, the collected data were saved, printed, and will be kept in my fireproof safe at home for 5 years. However, participants had full access to their own data at all times, as well as the dissertation chair and a peer reviewer.

Data Collection

Descriptive data were collected in this study which allowed me to explore and understand more complex questions by producing rich descriptions of the phenomena in question (Rubin & Rubin, 2005, p. 2). To do this exploration, semi-structured phone interviews were conducted following administration of the same interview questionnaire via email before the actual phone interview. This data collection source is preferable in this study since the participants are more likely to be widely dispersed and experience time constraints (Trochim, 2001, p. 110). Furthermore, the questions are not sensitive and are thus appropriate for phone interviews. The goal of qualitative interviewing is to achieve "a solid, deep understanding of what is being studied, rather than breadth" (Rubin & Rubin, 2005, p. 35). In so doing, I followed up initial responses with additional questions after interviews were conducted and analyzed.

The intent of this phone interview, preceded by an interview questionnaire, was to understand high school biology teachers' perspectives, practices, and challenges in relation to students with special needs in the classroom. Before the phone interviews, I developed an interview questionnaire that was pre-tested to ensure appropriate responses. Once revisions were made the interview questionnaire was employed in a pilot study that included four participants. The findings of this pilot study were used for the development

of a basic substantive model. Once the responses to the interview questionnaire were reviewed, additional information was needed to obtain saturated data.

As previously stated, I emailed the interview questionnaire prior to the phone interview. This questionnaire guided the phone interview. Also, during the interview I used probes to help participants expand on answers without changing the focus of the questioning (See Appendix A). Upon completion of the interview I transcribed the relevant responses and followed up with subsequent phone interviews that entailed follow-up questions to obtain clarification, depth, and/or detail (Rubin & Rubin, 2005, pp. 129-137). Once data from these interviews were gathered I proceeded with data analysis, searching for emerging themes or categories. These steps were followed with additional participants until the themes or categories became saturated, or when participants stopped providing new information. Creswell (1998) calls this procedure a "zigzag" process because the researcher is required to go out to the field to collect data, analyze the data, and then go back to the field to collect more data until saturation is reached (p. 57). I interviewed 15 high school biology teachers.

Evidence of Quality

I conducted member checking, peer review, and audit trail to ensure the quality of the study. At the conclusion of each interview, answers were reviewed with participants. Codes and application to collected data were reviewed with a fellow high school teacher. Detailed documentation of each step of the data collection and analysis process is kept in case verification is needed, and also to monitor and maintain the thoroughness and quality of the data.

Data Analysis

The grounded theory approach (Glaser & Strauss, 1967/2006) was the method utilized for analyzing data in this study. The purpose of grounded theory is to generate theory that "provides relevant predictions, explanations, interpretations, and applications" (p. 1). To do this, text was analyzed using constant comparison of data for their similarities and differences in order to generate categories. Glaser and Strauss (1967/2006) suggested that this method may be utilized to analyze "any kind of qualitative information, including observations, interviews, documents, artifacts, books, and so forth" (p. 104). Generated categories were coded. Coding is the analytical process that involves deriving of concepts from raw data that in turn are developed in terms of their properties and dimensions (Corbin & Strauss, 2008, p. 66). Open coding, axial coding, and selective coding was used to analyze data.

Open Coding

In open coding, data were broken down into distinct parts that are closely examined, compared, and conceptualized in order to name and form categories about the studied phenomenon. Categories were formed in terms of their properties (attributes/characteristics of category) and dimensions (location of property on a continuum). During open coding data were approached via line-by-line analysis. This analysis involved close examination of each phrase or single word, making it the most detailed type of analysis that was used to form initial categories (Strauss & Corbin, 1990, pp. 61-73).

Axial Coding

In axial coding the generated initial categories from the open coding were closely reexamined. In doing so, similar categories were combined to form core categories and possible subcategories. The emerged core categories and subcategories were incorporated in a substantive model that shows relationships among them.

Selective Coding

In this final coding process categories were integrated at a higher and more abstract level in order to select a core category. The core category was systematically related, by means of the paradigm model, to other categories, relationships among them were validated, and new categories were developed to fill the gaps in theory development (Strauss & Corbin, 1990, pp. 116-142). These coding procedures are not sequential; instead, they were operational concurrently until analysis was completed.

The data analysis process began as soon as I conducted the telephone interviews, preceded by IRB approval. This analysis started with comparison of incidents applicable to each category. In so doing, each incident in the data was coded into many categories as they emerge or as the data fit the already existing categories. The coded categories were recorded in a table created in a Microsoft Office Word document.

Pilot Study

The pilot study was conducted to test the usefulness/effectiveness of a questionnaire that gathered information to help understand high school biology teachers' perspectives, practices, and challenges in relation to students with special needs included in a regular biology course. According to Johnson and Christensen (2004) the purpose of

a pilot study is to find out whether a study produces intended outcomes, that is, whether it works properly (p. 177). In this pilot study four high school biology teachers who instruct students with and without special needs participated. The participants were selected using criterion-based selection and also the snowball sampling strategy. Upon informed consent, the participants were emailed the interview questionnaire in the form of an attachment. Once the questionnaire was completed, the participants emailed responses back to me. I reviewed the data generated from the questionnaire to see if answers fit well. The outcomes of this pilot study revealed that the questions worked well in capturing the understanding of the interview questions and in addressing the research questions. In the dissertation, probes were available for clarification purposes of the participants' responses and/or to obtain additional information. The probes were used on an individual basis and communicated to the participant(s) via phone interviews. Since the pilot study produced the intended outcomes and the sample size consisted of participants who possessed the same characteristics as the population of the dissertation study in the same setting, the findings from the pilot study were incorporated in the dissertation as an initial data source.

Summary

This study was based on a grounded theory design. The research questions focused on perspectives of high school biology teachers in regard to their instruction of students with special needs and obstacles/challenges experienced during student instruction. These perspectives and experiences revealed the strategies high school biology teachers use to teach students with special needs in a regular classroom. The role

of the researcher was an observer-as-participant. The setting of the study was a large public school district in the Midwestern United States. The participants were selected on the criteria of being a high school biology teacher who instructs students with and without special needs and they were recruited by the means of listserv and email. Ethical protection in this study included following appropriate procedures outlined by both the Walden Institutional Review Board and school district. The interview questionnaire used in the phone interviews was created by the researcher and tested for validity through a pilot study. The data were coded and analyzed by the means of a grounded theory methodology.

The results, conclusions, and recommendations are presented in chapter 4 and chapter 5.

Chapter 4: Results

Introduction

This grounded theory study was conducted in a large public school district in the Midwestern United States. The study collected data from 15 high school biology teachers through a series of phone interviews. The participants for the phone interviews were selected voluntarily with the aid of a science specialist within the public school system. Listserv and emails were used to recruit the participants. This chapter presents, examines, and discusses the findings in relation to the stated research questions.

The data collected were generated from in-depth semi-structured phone interviews. Twelve guiding questions were used for the phone interviews. Supporting probes were used as needed for the interview questions to allow for emerging rich responses (See Appendix A). Two rounds of phone interviews were conducted with the same participants. Doing so led to data saturation. Each phone interview lasted for 30-45 minutes. The phone interviews were taped, transcribed, and analyzed using Strauss and Corbin's (1990) three types of coding procedures: open coding, axial coding, and selective coding.

Audit trails were written in the form of a reflective journal to keep track of thoughts about the data analysis process and what was done. Field notes were collected and recorded in my reflective journal from each phone interview. Interview transcriptions were performed promptly after each phone interview. This transcription process allowed me to review the responses and see if probes/more questions should be

used in a follow up interview. I took notes and recorded them in the reflective journal during and after transcribing interviews.

Voluntary participants for this study included 15 biology teachers who work in an urban high school. They participated in phone interviews conducted from their home setting. Eleven out of 15 teachers hold master's degrees. About an equal number of males and females participated in this study. Their teaching experience varied from 3 years to 34 years. (See Table 1)

Table 1

Demographics of Interview Participants

Participants	Quantity
Biology Teachers	15
Context of Phone Interviews	
a) Urban/Home	15
School Level	
a) High School	15
Degree	
a) Baccalaureate	4
b) Master's	11
Sex	
a) Male	7
b) Female	8

(*Table 1 continues*)

Participants	Quantity
Teaching Experience	
a) 0 - 5 years	4
b) 6 - 10 years	5
c) 11 - 15 years	1
d) 16 - 20 years	2
e) 21 – 25 years	0
f) 26 – 30 years	2
g) 31-35 years	1

Data Analysis

Table 2

Research Questions by Number, Focus Areas, and their Data Gathering Instrument

Research Question	Focus Areas	Interview Question
1	Teachers' Perspectives on Learning Biology	1, 2, 3
2	Obstacles/Challenges in Learning	4, 5, 6, 7, 8, 9
3	Inclusion Teaching Strategies	10, 11, 12

The telephone interviews were taped using a speakerphone and tape recorder. Following the interview, recordings were replayed and transcribed by hand and transferred to computer. The interview transcripts were analyzed using a line-by-line approach and the three-step procedure: open coding, axial coding, and selective coding in line with the grounded theory methodology developed by Strauss and Corbin (1990). The categories that emerged were recorded in conjunction with major comments related to the category. The emerged codes and sub-codes were recorded in a Microsoft Word file called "data coding." The data analysis was guided by the following research questions:

1. What are high school teachers' perspectives on how students with special needs learn biology?
2. What obstacles/challenges do biology teachers face in instructing students with special needs?
3. What strategies do high school biology teachers use to teach students with special needs?

The research questions helped me to stay focused throughout the research. The research questions led to the development of the interview questions during the pilot study. The outcomes of the pilot study led to the refinement of the research questions for clarity. Also, possible probes were developed for the interview questions and used to help me obtain in-depth responses.

The Findings

The findings are presented in five different formats. The first format presents a synthesis of findings as related to each research question. The second format presents the first step procedure (open coding) recorded in Tables 3-5. The tables present categories from the open coding and the most typical comments stated by the participants. The third format presents data from the second step procedure (axial coding) in the form of bulleted core categories and corresponding subcategories. In addition, the data from axial coding are also presented in form of an outline and is considered as the fourth format of presentation of finding. Lastly, the third step procedure (selective coding) is presented in the form of a conceptual model that has emerged from the data. The model is presented in a narrative form of a storyline depicted in chapter 5. The five representations of data should help the reader follow and understand the process of data analysis and how the data emerged.

Participant Responses as Related to Each Research Question

Research Question 1

What are high school teachers' perspectives on how students with special needs learn biology?

In response to the first question, the majority of participants reported that ideally students should be able to think critically, follow instructions, read and write proficiently, take notes and be able to organize the notes in a form of graphic organizers, and relate current knowledge to prior knowledge. However, a few participants had a different

perspective. They reported that the students with special needs may develop those skills differently depending on their disability. This view is seen in the following quotes:

1. "Special needs students should be able to think critically, follow basic instructions, be attentive, read, write, and be persistent."

2. "The term 'special needs' encompasses many different types of learning difficulties, and 'one shoe does not fit all.' The special needs student must use the method of learning that is best for him or her. This could be reading the material aloud, rereading over and over, or writing the material while reading it."

3. "I think one of the most important skills that students use is their capacity to form organization schemes and mental maps with the information that they are learning. If they are able to fit in each new piece of information into their existing mental map of biology, then I usually find that they are able to retain that information and are quicker to master new ideas. When students have an inadequate mental map of how the previous concepts are linked together I find that they have a hard time learning."

Research Question 2

What obstacles/challenges do biology teachers face in instructing students with special needs?

In response to the second research question, participants reported that the major obstacle/challenge they are faced with is a large class size. Others reported additional challenges such as time constraints and difficulty in modifying lessons and needed materials. They also stated that students are not motivated, they do not pay attention, and

they lack critical thinking skills and reading comprehension skills necessary in learning biology concepts. This view is evident in the quotes below:

1. "Often students that are struggling go to other activities to preoccupy their time, often exhibiting behavior that attracts negative attention and distracts the rest of the class from applying (concentrating/learning) the material."

2. "Time management. Generally speaking, students with special needs are more labor-intensive because they need more cues to keep them on task and individualized attention to help with comprehension of material. This takes away from time spent keeping the curriculum on schedule and helping individual general education students. In addition, when the class size is large, even more students do not receive teacher assistance."

3. "Reading comprehension is not usually where it needs to be and often the students do not put any time or effort into their school work outside of the classroom, so moving ahead in the lesson is too slow. Finding modified materials or trying to create your own can be very time consuming and sometimes difficult."

Research Question 3

What strategies do high school biology teachers use to teach students with special needs?

In response to the third research question, participants reported the use of many different teaching strategies. Some reported the implementation of one-on-one teacher-student interactions and individualized tutoring to identify specific deficiencies a student may have and to provide prompt feedback and clarification. These interactions were reported to be helpful in planning lessons that address students' learning styles and academic needs. To address the different learning styles, teachers group students based

on their motivation and abilities. They also keep track of student progress and modify lessons accordingly. Many participants reported that they use repetition, graphics, animations and diagrams to aid in retention of the concepts and their organization. Still others provide students with printed notes, flashcards, and printed PowerPoint presentation note templates to be filled out by the students during the presentation. They also expect parents to take part in their child's learning process. During the presentation of new concepts some participants reported the use of scaffolding and activation of prior knowledge with information that is relatable to students. However, only one participant reported that the use of newspaper articles is helpful. Here is the list of quotes from several participants:

1. "I like to use flashcards for going over biological terms. I also like to print copies of notes so they can review them with the study guide."

2. "Doing graphics and animations to point out concepts. Fill in notes that follow PowerPoint presentation."

3. "In-class cues to keep students on task and engaged, individualized tutoring times, peer mentoring–carefully selecting students to sit next to those with special needs, diagrams and visuals to help processing and organization, and getting parents involved at home in helping their student study, and communication with parents."

4. "Keep students engaged by giving them individualized attention. When I read student work, I keep in mind where the student is coming from. If I see development from the beginning of the lesson to the end, that's progress."

5. "Breaking up concepts into small, digestible, and relatable bits of facts."

6. “The strategies that I have used include teacher-student one-on-one interactions, small group discussions, allowing them to work in groups with students who are highly self-motivated. Having one-on-one interaction with students with special needs, I am able to find out specifically what problems they are having, which often times range from difficulty understanding key scientific terms used in text to complete assignments. Through teacher-student interaction, I am able to provide feedback and clarification, which help the student complete the assignment and comprehend the key scientific terms.”

7. “Modify the lessons, presenting lessons in a variety of ways targeting differing learning styles and needs.”

8. “A more detailed ‘general’ introduction to the new unit/module, which should point them in the right direction and help them recognize relevant facts. A repetition of this, half way through the unit/module, but including more detail. This helps to keep them progressing in the right direction and often clarifies some of the confusion/lack of understanding. A detailed recapitulation of what has been covered, tying it to previously acquired concepts. Conduct informal discussions to tie what they have learned with things which are familiar to students. I found that using relevant newspaper articles is very helpful.”

Open Coding Data Tables

In order to begin to process and make meaning of the data, the data below were tabulated and gathered when I read and analyzed the open-ended interview questionnaire transcripts. To do this, I used the line-by-line analysis procedure to generate emerging

open coding categories for each research question. The categories were identified in the tables with their corresponding typical comments from the participants. Similar comments that were shared by more than one participant were noted in the parenthesis next to the comment. The categories and their corresponding typical comments were recorded in a Microsoft Word file. Tables 3 to 5 show the emerging open coding categories and the corresponding typical comments of the participants. The typical comments that best reflect/explain the open coding category were chosen from the collected data.

Interview Findings

The transcribed data were analyzed line-by-line, leading to the emergence of initial codes. These codes were collapsed and resulted in the code categories listed in tables 3-5. A list of initial codes and a sample-coded interview is provided in Appendices D and E respectively.

Open Coding Data

Table 3

Research Question 1: What are High School Teachers' Perspectives on How Students with Special Needs Learn Biology?

Open Coding Categories	Participants' Typical Comments
1. Skills necessary in learning	"Special needs students should be able to think critically, follow basic instructions, be attentive, read, write and be persistent."(4) "Understanding/comprehension is absolutely

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
1. Skills necessary in learning	dependent on students' ability to sequence/organize new information, plus the ability to integrate newly learned concepts with those that have been learned previously, and based on these drawing logical conclusions (not necessarily correct ones)." (3) "Organizational skills, graphic organizers, note taking skills, reading comprehension."(3) "…special needs students need to learn "how to study" to be most successful in biology." "[Participate in] Labs, field trips, and interactive exercises would be examples of practical/applied approaches." "The most basic skills (reading, understanding mathematical concepts) are

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
1. Skills necessary in learning	mandatory for any core subject." "Relate vocabulary words to the diagrams/drawings." (2) "Look carefully at diagrams and drawings as they [students] read the topic." (2) "Repetition of vocabulary words and concepts, interactive diagrams and flowcharts." "Use combination of skills to perform lab activities. That is, listening to instructions that the teacher may provide before and during the lab, read the instructions to carry out the lab. Also, they will need critical thinking skills to analyze and interpret data and graphs." "The special needs student must use the method of learning that is best for him or her. This could be reading the material aloud, rereading over and over, or writing

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
	notes while reading it."
2. Skills used by students	"Memorization, reading & comprehension, listening skills, studying, repetition/rote, practice, critical thinking skills." (5)
	"Organizational skills, note taking skills, comprehension skills, observation skills."
	"The most important skills a student needs are study skills."
	"Students mainly memorize biology."
	"…reading, understanding mathematical concepts…"
	"Use glossary to define words - not good."
	"…capacity to form organization schemes and mental maps with the information that they are learning….to fit in each new piece of information into their existing mental map of biology."

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
2. Skills used by students	"…comprehension skills, the ability to connect with their prior knowledge, and openness to learning…" "Content knowledge, analysis, graphing, math, reading comprehension, application, synthesis." "…making observations, analyzing results, and recognizing patterns."
3. Struggling students with special needs	"Most special needs students take a longer time in completing assignments and projects due to poor reading and comprehension skills." (4) "Often students that are struggling go to other activities to occupy their time, often exhibiting behavior that attracts negative attention and distracts the rest of the class from applying (concentrating/learning) the material." (2)

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
3. Struggling students with special needs	"Most of the special needs students are not very good at time allocation and scheduling." (2) "Students seem to have difficulty relating many of the concepts to one another and to prior knowledge." (3) "Often times I see a lack of general science knowledge in students." "They rarely ask for help from the teacher and they often copy from other students." "Students …do not pre-read book/notes before assignments." "…students do not engage and master the material as successfully when they have to read it on their own." "There is a much lower level of engagement and investment in school. Many come to class only sporadically. Most of my students that show overt gang affiliation are also

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
3. Struggling students with special needs	special needs students." "The amount of new vocabulary seems to be overwhelming." "When new vocabulary and concepts are taught as a general text I find that students with special needs struggle with organization of new information." "…have trouble with directions and memory." (2) "Students who read below their grade level may not understand all of the content material and as a result they often need extra support." "…those with auditory problems cannot follow oral directions." "Some students lack motor skills and cannot do the class projects that require dexterity needed for putting together, or making models or doing the assigned lab work."

(Table 3 continues)

Open Coding Categories	Participants' Typical Comments
3. Struggling students with special needs	"Some student's cognitive skills, or lack thereof, do not allow them to understand what is going on in class." "At home their parents usually are unable to help them since many of them do not understand their child's special needs." "Meeting with parents or students before or after class in a confidential setting can provide better understanding of any gaps or problems the specific student may be having."

Note. Responses reflect the teachers' perspectives in regard to the ways students with special needs learn biology (*N=15*)

Table 4

Research Question 2: What Obstacles/Challenges Do Biology Teachers Face in Instructing Students with Special Needs?

Open Coding Categories	Participants' Typical Comments
1. Requirements for successful inclusion	"I need full support of their [students'] parents and special education teacher throughout the school year." (6) "Overall class size is kept small, number of special needs students should not be above 6 ideally and definitely never more than 10." "Teachers should be provided with extra periods which would include only special needs students and which would be devoted to any extra help and presentation of new concepts; special education teacher is assigned to work on a daily basis with the classroom teacher, and is present for all the class periods." (3) "Need a person who is qualified to make the appropriate modifications." (5) "I need to have a small amount of special needs students in my class in order to

(Table 4 continues)

Open Coding Categories	Participants' Typical Comments
1. Requirements for successful inclusion	successfully educate them without bringing down the level of education for my regular needs students." (9) "smaller class size and a lower percentage of special ed students." (2) "This is where (regular classroom) students really learn to make adaptations for their disability." "the most important support comes from the student." "Inclusion works well if there is enough support for both the regular classroom teachers and the student in order for both of them to succeed." (3) "The severity of the problem [disability] determines if the child can function properly in the average classroom." (2) "[need] more preparatory time to design projects according to the needs of the

Open Coding Categories	Participants' Typical Comments
1. Requirement for successful inclusion	students." "Time management - setting specific study time at home." "Increased tutoring in school and at home in reading and math." "Need regular allotted time to meet with a special education teacher to discuss the needs and progress of each special needs student." (5) "a highly skilled special education teacher as a co-teacher or at least an available sp. ed. teacher as a resource during the class time." (2) "IEPs that are current and reflective of the students' needs." (2) "Special education teachers in inclusion classrooms assist students' learning in and outside of general education times. These teachers should be actively involved in the general education class." (2)

(Table 4 continues)

Open Coding Categories	Participants' Typical Comments
1. Requirement for successful inclusion	"Special education teachers that have manageable case loads." (2)
2. Challenges/obstacles in learning biology	"The main challenge and/or obstacle is the ability of students with and without special needs to think critically, follow basic instructions and read about the topic in question from their textbook." (2) "Large numbers [of students with special needs]. Inadequate time." (3) "Teaching special needs students who are not able to relate and translate the subject matter into language more comprehensible for them. Also, special needs students have a more transient attention span which often is an obstacle to them when learning often very simple concepts."(2) "…students do not put any time or effort into their school work outside of the classroom."

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
2. Challenges/obstacles in learning biology	"Finding modified materials or trying to create your own can be very time-consuming and sometimes difficult" "[students do not] retain and apply the information they learn in class." "The main challenge is showing special needs students that they can be successful." "Resistance to reading - not putting in the time to understand concepts." "They [students] are motivated by different factors, respond to teachers in different ways, struggle with different concepts and skills. They also have their own unique set of strengths and abilities. The challenge, therefore, lies in reaching each different student."

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
2. Challenges/obstacles in learning biology	"Time management. Students with special needs are more labor intensive because they need more cues to keep them on task and individualized attention to help with comprehension of material." (2) "Literacy and lack of academic skills are the biggest challenges." "The special needs students can experience frustration with not being able to understand or being able to accomplish the required work, which in turn, can lead to other problems, such as giving up entirely or becoming a behavior problem."
3. Skills/training	"…one can always use more training in the latest techniques for improving comprehension, modifying the materials so that they are more appropriate." (4)

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
3. Skills/training	"the ultimate requirement would not be more instruction/training for the teacher but smaller class size and more faculty support." (2) "I do not have all the necessary skills/training to deal effectively with special needs students and it is for this reason I need ongoing support from their parents and special need teachers." (3) "I think a degree in special education is what truly makes you qualified to teach them." "[need] workshops/professional development more specific to the subject & disability…" (2) "Subject specific and topic specific staff development are the only types that I think are useful."

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
3. Skills/training	"I would really like training on how to help students with reading and writing: note-taking skills, comprehension, summarizing." "Reading and math methods training." "I took the required special education course required for teacher certification." (3) "…to hear from former students about how they succeeded." "I cannot say that I have enough skills to cover the gamut of problems this group of students could possess." "I have taken classes on adolescent special needs." "I have been through a countless number of staff development meetings on this subject." (3).

(*Table4 continues*)

Open Coding Categories	Participants' Typical Comments
3. Skills/training	"Generally I've found that staff development is a waste of time that could be better served working with peers to design a more comprehensive curriculum." (2) "I took a special needs class when working on my master's, it was minimally helpful." (2) "I feel like I have the skills that I need for the most part. There are some types of disabilities that I am not familiar with but I'm confident that I can be successful with all students if I have reasonably small class sizes, freedom to be creative and adequate resources."(2) "My experience seems to be my best training yet." (2) "The best training I have received has been self-sought-out from meetings with special education teachers and IEP meetings."

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
3. Skills/training	"I have had little pre-service training in the area of students with special needs." "I have had ongoing staff development over the years: Differentiated learning, How to decipher IEPs, The difference between ADD and ADHD, Modifying tests." "One of the courses that I have taken which helps in dealing with special needs students is Differentiated Instructions." "I would like training on creating lessons using the idea with brain developments. For example, how to capture the attention of an ADD brain…" "Special education teachers could provide real cases/scenarios about special need students to the regular education teachers, who would analyze the situation and then discuss how to handle each case/scenario."

(*Table 4 continues*)

Open Coding Categories	Participants' Typical Comments
3. Skills/training	"Introduction to proven strategies and intervention techniques to help the student given by special ed teachers to the class room teacher would be of help."

Note. Responses from participant concern the obstacle/challenges teachers face in inclusive classroom (*N=15*)

Table 5

Research Question 3: What Strategies Do High School Biology Teachers Use to Teach Students with Special Needs?

Open Coding Categories	Participants' Typical Comments
1. Effective teaching strategy	"One strategy that I find effective in teaching special needs students in biology is to tap into their background. That is, have them identify by discussing or make a list of all the things they know about the topic/s. In so doing, I can build on what they already know and also eradicate any misconceptions that they might have about the concept/s." (3)

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
1. Effective teaching strategy	"small group based learning modules, interactive/illustrative methods, repetition of fundamental concepts (5), daily end of class quizzes, and weekly exams instead of chapter exams." "Modifying the lessons, presenting lessons in a variety of ways targeting students' differing learning styles." (3) "Role-play, laboratories, note print-outs, study guides, game reviews, visual aids"(2) "I like to use flashcards for going over biological terms." "…draw real life examples from subject material to their life experiences or daily experiences using analogs that bridge over to subject material being taught…"

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
1. Effective teaching strategy	"Doing graphics and animations to point out concepts." "Doing synonyms for the vocabulary-having students group like terms from a group(s) of terms." "fill in notes that follow PowerPoint presentations." "I use an overhead projector to go over the notes that I typed and passed out, and I repeat every thing that was in the notes." "I find that repetition of main ideas is very successful with special needs students. I find that they need practice time to solidify concepts." (3) "I find that modeling followed by guided practice and prompt feedback works best for teaching all students."

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
1. Effective teaching strategy	"with special ed kids I try to build their confidence a bit more. I will still expect them to display their knowledge publicly but I will hold off until I know they will experience some degree of success." "Using a variety of styles of lessons with many visuals and hands on opportunities, scaffolding, activities that help students to learn vocabulary…designing student centered activities…pairing students based on their strengths and needs." (2) "in-class cues to keep students on task and engaged, proximity, peer mentoring, getting parents involved…" "Keep students engaged by giving them individualized instruction; keep track of student's progress." (2) "Use more probing, positive feedback with specific indications."

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
1. Effective teaching strategy	"Graphic organizers (Venn diagrams, tables, flowcharts, and concept maps); Cornell Note Taking Technique; Before, During, and After (BDA) reading strategy."
2. Classroom management strategies	"I need to tailor my approach/management to suit each one [classroom] specifically." (2) "Sometimes grouping special needs students together where I can give them more time and attention works well." (3) "Sometimes, distributing special needs students among different teams (each team consists of 5 students sharing a large table) where they have the support of their fellow students have great results." (2) "I try to treat everyone equally." (4) "I make sure that the classroom rules are clearly laid out and followed." (3)

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
2. Classroom management strategies	"I feel it is most important for the students to respect you and each other." (8) "…have defined boundaries and established expectations of the students." (2) "My classrooms are disciplined but relaxed. Students can talk about anything they want but they have to be courteous and respectful to others." "Be on time. Bell ringers. Be attentive during class presentation. Get assignments turned in on time." "…show that you respect students by respecting their time. That means no 'free days.' I always have a lesson that I think will help them to learn." "Keeping students on task at all times…complete warm-up activity…list objectives and assignments."

(*Table 5 continues*)

Open Coding Categories	Participants' Typical Comments
2. Classroom management strategies	"I am organized and try help students to be organized. I have a routine for class, but also try to vary things enough to keep it interesting." (2) "I try very hard to take an interest in each student and to get to know them or to at least find something that we have in common or can connect with." "I have all students keep an organized biology binder." "I also find maintaining an orderly classroom with visual stimulation is the key." "Team work-allow students to choose their own partners. This creates trust between each other and with me and them."

Note. Responses concern the strategies high school biology teachers use to instruct students with special needs (N=15)

Axial Coding Data

During axial coding I reread the transcripts and continued analyzing emerged data from the open coding. In so doing, the core categories and subcategories were discovered for each research question as listed below. Each core category was developed from the key phrase of the survey questions that were designed to address each research question. The core categories are presented in bold print followed by the bulleted subcategories. The listed subcategories are related to the specific core category. In other words, I looked at relationships between the core categories and their subcategories. After the categories and subcategories emerged and were listed below I analyzed them again and looked for relationships between codes and sub-codes. These outcomes are presented in the form of an outline below the bulleted categories and subcategories.

Research Question 1: What are High School Teacher's Perspectives on How Students with Special Needs Learn Biology?

Research Question 1: Question Focus- Teacher's Perspectives on Learning Biology

Skills required
-Critical thinking
-Following instructions
-Reading Comprehension
-Writing
-Perseverance
-Attentiveness
-Note taking
-Use of graphic organizers
-Organization of new information
-Relate current knowledge to previous knowledge
-Interpretation of visual aids
-Auditory skills
-Hands-on activities/manipulative skill

Skills used by the students
-Critical thinking
-Listening
-Reading
-Comprehension
-Studying
-Rote memorization
-Recognizing patterns
-Organize new information
-Note taking
-Making observations
-Visual
-Auditory
-Hands-on
-Memorization

-Math skills
-Computing skills
-Use interactive diagrams/flowcharts
-Repetition of vocabulary words/concepts
-Differentiated skills/ability
-Literacy
-Interpret data/graphs

-Math skills
-Computing skills
-Form mental concept maps
-Synthesis
-Analysis
-Graphing
-Literacy
-Application

Characteristics of a Struggling Student With Special Needs:

-Need more time to complete work
-Off task
-Distracts other students
-Feels discouraged
-Misbehavior
-Lack of higher learning achievement
-Lower level of engagement in school
-Lower investment in school
-Gang affiliated
-Give up

Reasons for Struggling:

-Poor reading skills
-Poor comprehension skills
-Poor organization skills such as time allocation and scheduling
-Lack of parental support due to their own limited education
-Large class size
-Teacher did not provide clear expectations/goals of the lesson
-Lack of general science knowledge
-Inability to organize new information
-Inability to follow/comprehend directions
-Inability to retain/memorize concept
-Lack of motor skills
-Auditory problems
-Cognitive problems

Research Question 2: What Obstacles/challenges do Biology Teachers Face in Instructing Students with Special Needs?

Research Question 2: Focus Question- Obstacles/challenges in Learning

Requirements for Successful Inclusion

-Special education teacher support
-Parental support
-Modified teaching materials/ lesson plans
-Teacher training in modifying materials
-Small class size
-Qualified special ed teacher
-Co-teaching
-Motivation to learn

Challenges/Obstacles in Learning Biology

-The lack of reading comprehension
-The lack of motivation to learn
-Time constraints and difficulty in modifying lessons/materials
-The lack of critical thinking skills
-The lack of attentiveness
-Large class size
-Students do not retain/apply learned concepts
-The lack of time for individualized

-Common/complementing teaching style
-Lower percentage of students with special needs
-Special education teacher with manageable case load
-Updated and on time IEPs
-Administrative support
-Special needs teacher with single subject area

Skills and Training
-Most teachers welcomed training
-Training and skills are not the problem but a large class size and the lack of faculty support
-Workshops/professional development should be subject, topic and disability specific
-Need courses to improve pedagogical skills
-Requires degree in special education
-Took mandatory special needs class for certification
-Analyze real case scenarios
-Differentiated instruction course
-Experience
-Use updated IEPs
-IEP meetings
-Need assessment modification
-Special education teacher should model effective teaching strategies
-Little pre-service training

attention
-The lack of literacy and academic skills
-The lack of general science background

Research Question 3: What Strategies do High School Biology Teachers use to Teach Students with Special Needs?

Research Question 3: Focus Question-Inclusion Teaching Strategies

Effective teaching strategies

-Relate prior knowledge to current topics
-Detailed general introduction to a unit, lead to relevant facts, lead to repetition half way through the unit, lead to repetition after covering the unit, lead to informal discussion
-Use relevant articles
-Small group based learning modules
-Interactive/illustrative methods
-Involved teaching sessions

-Breaking up concepts into small/ digestible/relatable bits of facts
-Repetition of fundamental concepts
-Daily end of class quizzes
-Weekly exams instead of chapter exams
-Modifying lessons
-Addressing different learning styles
-Role-play
-Laboratories
-Note printouts
-Study guides
-Game reviews
-Visual aids
-Use of analogies
-Model activity/behavior
-Guided practice
-Prompt/positive feedback
-Individualized tutoring
-Provide individualized attention
-One-on-one interaction
-Peer mentoring
-Parental involvement
-Teacher-student one-on-one interaction/proximity
-Class cues
-Keep track of progress

Classroom management strategies

-Keep things organized/binders
-Treat all students the same way
-Peer teaching

-Enforce more strict lead to repetition after

-Small group discussions
-Group students in terms of their level of motivation
-Teacher-student one-on-one interaction/proximity
-Group special needs students together
-Group special needs students with their fellow peers without special needs
-Enforce class rules
-Maintain respectful atmosphere
-Parent/teacher/student conferences
-Correct bad behavior
-Keep students engaged-no “free time”
-Routine class procedures
-Visual stimulation
-Hands on activities
-Team work
-Warm-up activity
-Keep students on task at all times
-Outline lesson objectives
-List assignments
-Provide enrichment activities

-Use more probing
-Graphic organizers
-Venn Diagrams
-Tables
-Flow charts
-Concept maps
-Cornell Note Taking Technique
-Reading strategy (before, during and after)

The resulting codes and subcodes are listed below:

A. Skills Required for Learning Biology
    1. Graphic Organizers
        a. Visual Aids
        b. Interactive Diagrams
        c. Interactive Flowcharts
    2. Literacy
        a. Critical Thinking
        b. Following Instructions
        c. Reading Comprehension
        d. Writing
        e. Auditory Skills
        f. Note Taking
    3. Relation of Current Knowledge to Previous Knowledge
    4. Hands-On Activities
    5. Math/Computation
B. Skills Used by the Students
    1. Graphic Organizers
        a. Visual Aids
        b. Organize New Information
    2. Literacy
        a. Critical Thinking
        b. Reading
        c. Comprehension
        d. Note Taking
        e. Auditory Skills
    3. Concept Retention by:
        a. Studying
        b. Repetition
        c. Memorization
        d. Practice
        e. Hands-On Activities
        f. Form Mental Concept Maps
        g. Using Prior Knowledge

4. Science/Math Processes
    a. Observation
    b. Analysis
    c. Application
    d. Graphing
    e. Computation
    f. Synthesis

C. Characteristics of Struggling Student with Special Needs
1. Need More Time to Complete Work
2. Off Task
3. Distracting Other Students
4. Feeling Discouraged
5. Lack of Higher Learning Achievement
6. Lower Level of Engagement in School

D. Reasons for Struggling
1. Poor Literacy Skills
    a. Poor Reading Skills
    b. Poor Comprehension Skills
2. Poor Organization Skills
    a. Time Allocation
    b. Scheduling
    c. Inability to Organize New Information
3. Lack of Parental Support
4. Large Class Size
5. Lack of General Science Knowledge

E. Requirements for Successful Inclusion
1. Support Provided by Special Education Teacher
    a. Modify Teaching Materials
    b. Modify Lesson Plans
    c. Train Regular Education Teachers in Modifying Materials
    d. Provide Updated IEPs (Individualized Education Plans)
2. Characteristics of a Special Education Teacher
    a. Highly Qualified
    b. Practice Co-Teaching
    c. Has Manageable Case Loads
    d. Familiar with subject matter
3. Parental Support
4. Small Class Size
5. Students are Motivated to Learn
6. Lower Percentage of Students with Special Needs in Inclusive Classroom

F. Challenges/Obstacles in Learning Biology
1. Students Exhibit the Lack of:
    a. Reading Comprehension
    b. Motivation to Learn

c. Critical Thinking Skills
d. Attentiveness
e. Students Do Not Retain/Apply Learned Concepts

2. Regular Education Teachers' Challenges
   a. Time Constraints
   b. Difficulty in Modifying Lessons
   c. Difficulty in Modifying Teaching Materials
   d. Large Class Size

G. Skills and Training for Teachers
   1. Teacher Receptiveness to Training
      a. Most Teachers Welcomed Training
      b. Some Teachers Preferred Small Class Size and Faculty Support Instead of Training
   2. Workshops/ Professional Development
      a. Subject Specific
      b. Topic Specific
      c. Disability Specific
      d. Assessment Modification
      e. Model Effective Teaching Strategies
   3. Approaches Employed by Regular Biology Teachers
      a. Use Updated IEPs
      b. IEP Meetings
   4. Pre-service Training
      a. Took a Mandatory Special Needs Course

H. Effective Teaching Strategies
   1. Interactive Methods
      a. Small Group Activities
      b. Role Play
      c. Game Reviews
      d. Use of Analogies
      e. Model Activity
      f. Teacher-Student One-On-One Interaction
   2. Graphic Organizers/Illustrative Methods
      a. Visuals Aids
      b. Diagrams
      c. Flowcharts
   3. Lesson Planning
      a. Modify Lessons in Accordance to Students' Needs
      b. Address Different Learning Styles
   4. Assessment
      a. Weekly Exams Instead of Chapter Exams
      b. Daily End of Class Quizzes
      c. Prompt Feedback

5. Study Aids
    a. Note Printouts
    b. Study Guides
    c. Flashcards
6. Tutoring
    a. Peer
    b. Individualized
7. Relate Prior Knowledge to Current Topics
8. Use Relevant Articles
9. Break up Concepts into Small and Relatable Bits of Facts
10. Repetition of Fundamental Concepts
11. Informal Class Discussions
12. Parental Involvement

I. Classroom Management Strategies
1. Behavioral
    a. Enforce Class Rules
    b. Maintain Respectful Atmosphere
    c. Teacher/Student/Parent Conferences
    d. Correct Inappropriate Behavior
    e. Routine Class Procedures
    f. Keep Students Engaged, No "Free Time"
2. Instructional
    a. Keep Things Organized
    b. Use Binders for Organizational Purposes
    c. Peer Teaching
    d. Small Group Discussions
    e. Group Students in Terms of Their Motivational and Ability Level
    f. Teacher-Student One-On-One Interaction
    g. Keep Students Engaged, No "Free Time"

The diagrams in Figures 2 and 3 were developed during axial coding. During the axial coding process I reanalyzed the outlined codes and subcodes. Several codes and subcodes were further collapsed and led to the development of the two initial diagrams. These diagrams were used as a tool that helped me to visualize the emerged core categories and corresponding subcategories. The initial diagrams have also helped me to think about the relationships between the codes and subcodes. The purpose of these diagrams is to "help you [the researcher] to gain analytical distance from materials. They

assist your [the researcher's] movement away from the data to abstract thinking, then in returning to the data to ground these abstractions in reality" (Strauss & Corbin, 1990, p. 1999).

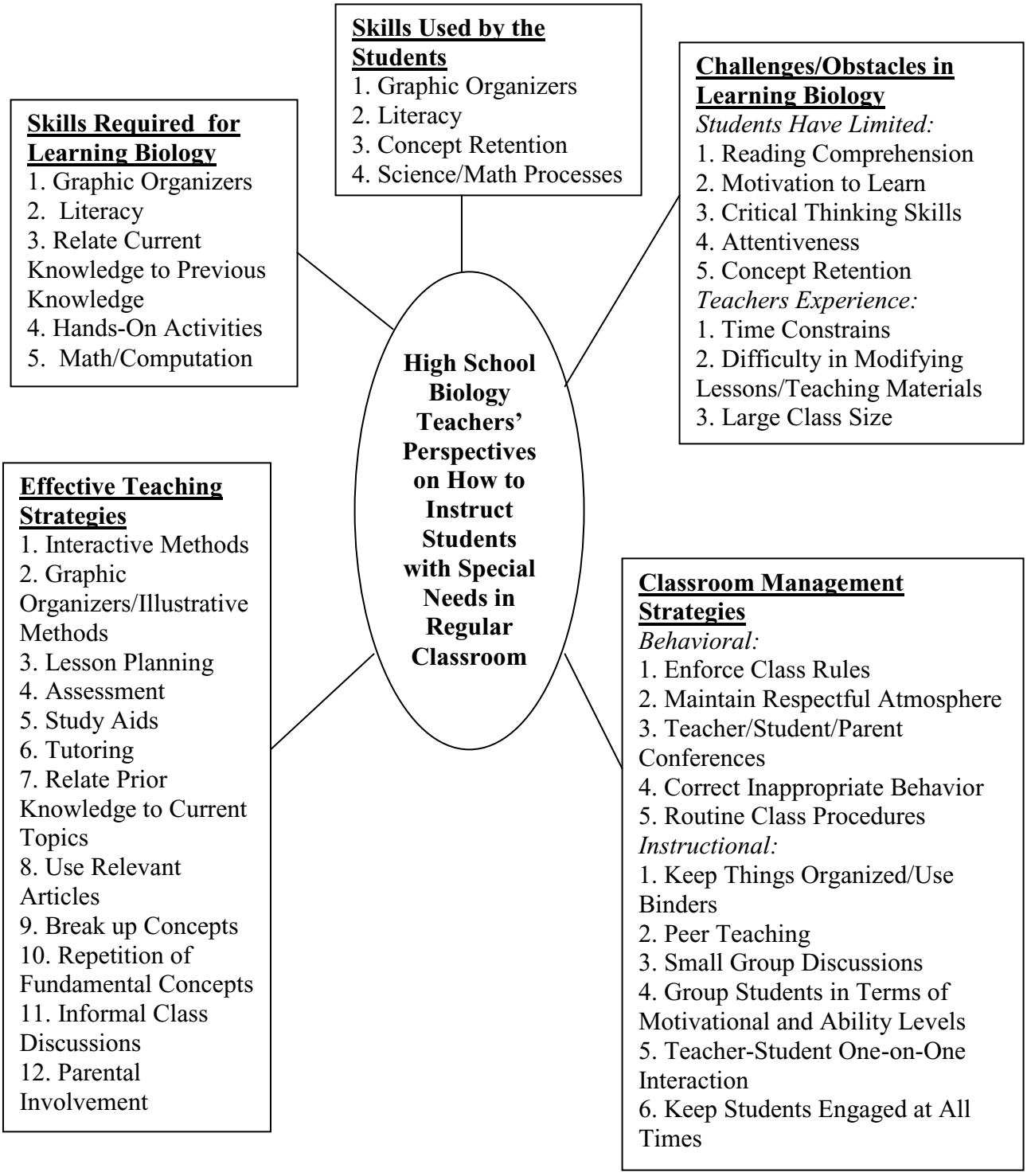

Figure 2. Analytical diagram from axial coding: Part 1

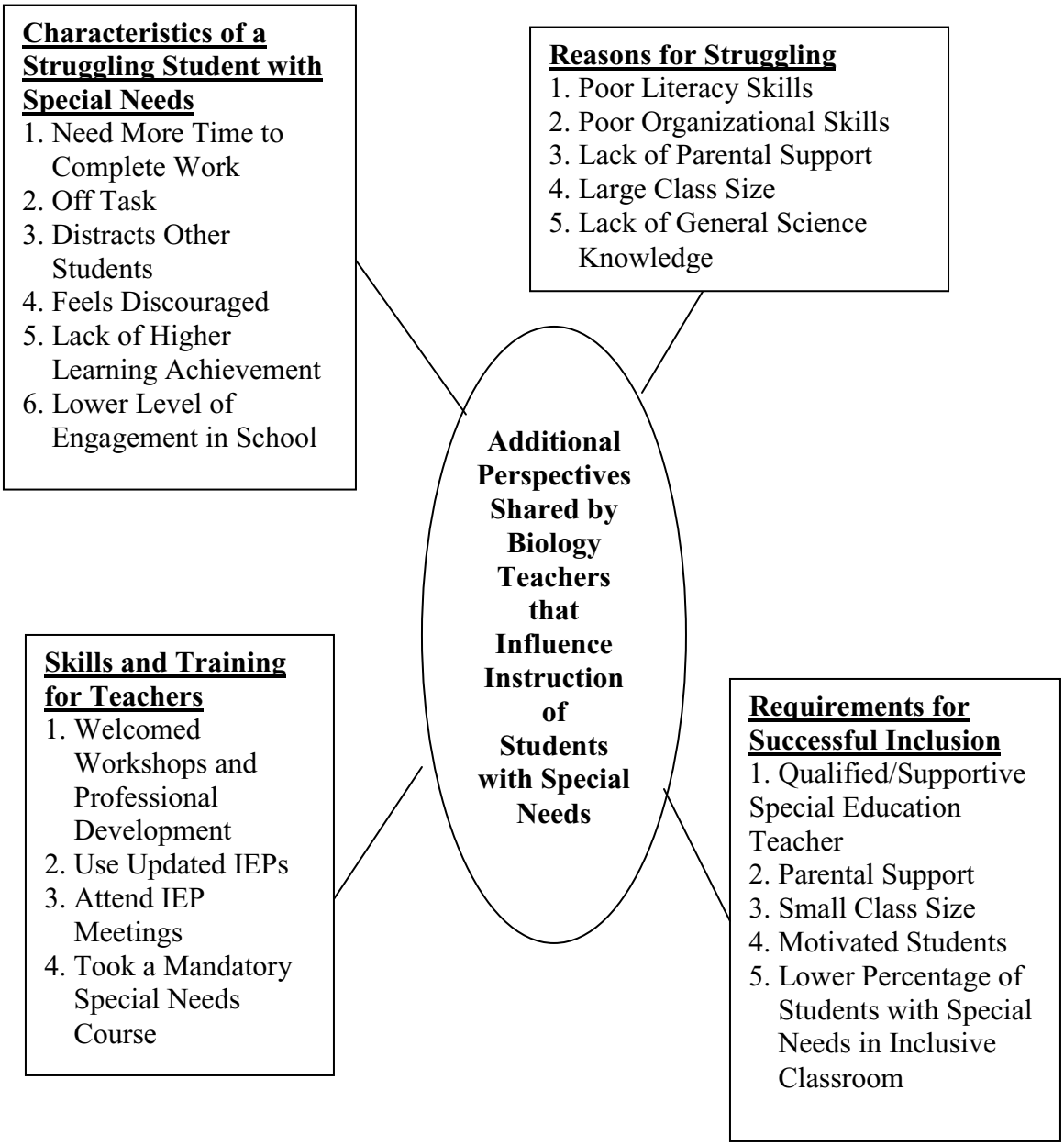

Figure 3. Analytical diagram from axial coding: Part 2

The diagrams present high school biology teachers' perspectives in regard to teaching students in an inclusive setting. They are depicted in a loose form, i.e. ideas, codes, and subcodes are listed without relationships among them. At this point of analysis these diagrams appear awkward. The awkwardness is in line with Strauss and Corbin's (1990) explanation of diagram features; "In the beginning stages of analysis, memos and diagrams may appear awkward and simple" (p. 1999). The awkwardness of the diagrams is also justified by Strauss and Corbin (1990), who stated, "diagrams evolve. They grow conceptually in complexity, density, clarity, and accuracy as the research and analysis progress" (p. 1998). These diagrams have helped me focus thinking and see in detail how the categories interact and influence each other. Close analysis and further probing into the data led to the development of a conceptual model. The model includes the effective approaches for teaching biology in inclusive classroom and is discussed in chapter 5.

Summary

This chapter presents the findings from the research study. The grounded theory methodology implemented in this study to analyze data has yielded a significant amount of information. The findings contributed to the development of the two analytical diagrams during the axial coding. Also, the emerged information provides insight to the development of a conceptual model that shows the effective approaches that high school biology teachers use when they instruct students with and without special needs.

The participants in the study were willing to respond to the interview questions and their input has provided insight in regard to the teaching strategies they use in their

classrooms. They have provided information that was used in the development of a conceptual model that reflects the effective approaches for teaching biology in an inclusive classroom. Much of the information they have provided is guided and grounded in the perpetual cycle of improvement framework developed from the pilot study.

Chapter 5 presents effective teaching approaches for high school biology teachers in the form of a model that is substantively generated from the research findings. The chapter also presents the interpretation of the findings as selective coding, implications for social change, recommendations, and conclusions.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

There is no existing model of effective approaches for teaching biology in an inclusive classroom. I developed the perpetual cycle of improvement model through a pilot study to provide the basis for this research study. The model is based on teachers' perspectives and practices in an inclusive context – that is, a biology classroom where students with and without disabilities are instructed at the same time. It is important that current and future high school biology teachers and special education teachers are provided with an instructional model that will help the teachers improve biology learning.

The model of perpetual cycle of improvement underwent changes as data were processed and analyzed. Having a model undergo changes is in line with the grounded theory methodology approach. In so doing, the final model may contradict, support, and clarify earlier ones (Strauss & Corbin, 1990, p. 198).

This qualitative research study employed the grounded theory methodology to focus on the teaching approaches high school biology teachers use effectively to instruct students with and without special needs. The purpose of this grounded theory study was to understand high school biology teachers' perspectives, practices, and challenges in relation to teaching students with special needs. The perpetual cycle of improvement framework was developed by me through the pilot study and was used as a conceptual framework that grounds this study.

In this chapter, the core categories and the subcategories have emerged from each research question and are discussed as the interpretation of findings. The chapter

presents the substantive model of effective instructional approaches generated from the research results. A comparison of the generated model from the results with the conceptual framework model generated from the pilot study is also presented. In addition, the chapter presents a summary of conclusions, implications for social change, and recommendation for action and future study. Finally, I reflect upon the research experience.

Data for the study were collected through in depth semi-structured phone interviews. Following data collection, transcription took place and the three step coding process from Strauss and Corbin (1990) was employed to analyze the data. This research study was guided by the following research questions

1. What are high school teachers' perspectives on how students with special needs learn biology?
2. What obstacles/challenges do biology teachers face in instructing students with special needs?
3. What strategies do high school biology teachers use to teach students with special needs?

The findings from this study identify the learning skills students with special needs should have acquired and the struggles they experience. Simultaneously, the biology teachers also report on the challenges and obstacles they are experiencing when inclusion is practiced. Finally, the effective teaching strategies that high school biology teachers employ to instruct students with and without special needs were generated from the research findings.

Interpretation of Findings

The interpretation of findings from this study addressed all of the research questions. The core categories emerged from each research question and are presented as the selective coding component of the grounded theory methodology. This final coding step presents the data in a narrative form. These findings are also related to a larger body of literature and the conceptual framework that provided justification for this study.

Selective Coding Data

Research Question 1

What are high school teachers' perspectives on how students with special needs learn biology?

Core Category – Skills Necessary in Learning

Several participants reported that students with special needs have different disabilities and thus the skills they use to learn are different. This variability is reported in chapter 4 by one participant who stated that, "The term 'special needs' encompasses many different types of learning difficulties, and 'one shoe does not fit all.' The special needs student must use the method of learning that is best for him or her." The majority, however, expected students with special needs to be able to develop and understand graphic organizers such as visual aids, interactive diagrams, and interactive flowcharts. The participants also emphasized the importance of literacy by indicating the need for special needs students to think critically, follow instructions, write, take notes, and comprehend the reading material. Still others reported that students should be able to

participate in hands-on activities, relate current knowledge to prior knowledge, and perform basic math calculations.

The findings indicate that the majority of the participants have predetermined expectations in terms of learning skills the students with special needs should have acquired. The belief is that the majority of participants may not be fully aware of the individual needs of each student. This lack of awareness may stem from the lack of collaboration between the biology teacher and the special education teacher. The special education teacher may have failed to deliver an IEP that provides guidelines for the biology teacher. It is also possible that the biology teacher does not follow, or fully comprehend, the IEP.

Also, participants may hold high expectations of all their students because they feel that they modify lesson plans correctly after collaboration with the special education teachers. Moreover, some may feel that they are adequately competent in the implementation of the IEP guidelines that should lead to the improvement of the learning skills necessary for the students with special needs.

Core Category – Skills Used by Students

The findings from this category indicate the learning skills used by students in general. The participants reported that students are able to form and understand graphic organizers such as visual aids, and thus are able to organize new information. One participant stated that students should use "a combination of skills like visuals, audio, and hands-on to make sure that a concept has been reinforced." Another one mentioned that students use "Organizational skills, note taking skills, comprehensions skills, and

observation skills." This use of skills indicates the importance of literacy skills. In other words, students in biology classroom should be able to read and write in order to comprehend biological concepts. Those skills should be applied further when students listen to a lesson delivery and are able to take notes simultaneously. The notes should be later reviewed and outlined. Doing so reinforces the understanding of new concepts. Taking notes in the form of outlines, concept maps, or other graphic organizers should also be done while reading a textbook and/or other reading material. Also, hands-on activities require strong literacy skills since students are required to read directions, and /or follow a given procedure, or write their own procedure.

The importance of literacy skills are also reported by another participant who said that the basic skills like "reading and understanding mathematical concepts are mandatory for any core subject." Possessing these basic skills is especially important for all sciences where measuring and use of laboratory equipment is common during scientific inquiry. Also, participants reported that students use science and math processes when learning biology, such as observation, analysis, application, graphing, synthesis, and computation. These processes are evident when students conduct laboratories which require the application of scientific method and basic math knowledge. Doing so reinforces comprehension and retention of biologic concepts. In addition, students retain the new biological concepts by studying, repetition, memorization, practice, hands-on activities, form mental concept maps, and activate prior knowledge. The ability to form mental concept maps is evident in a statement provided by one of the participants,

> One of the most important skills that students use is their capacity to form organization schemes and mental maps with the information that they are learning. If they are able to fit in each new piece of information into their existing mental map of biology, then I usually find that they are able to retain that information and are quicker to master new ideas. When students have an inadequate mental map of how the previous concepts are linked together I find that they have a hard time learning.

Core Category – Struggling Special Needs Students

All of the participants reported that students with special needs struggle in their biology classroom. The majority reported that struggling students with special needs take longer time to complete work, they exhibit lower interest in school, show lack of higher learning achievement, feel discouraged, and distract other students. One experienced teacher stated that, "students with special needs take more time to complete an assignment and are more successful with concrete examples so they understand the expectation(s) of the assignment." Another participant commented that, "Often times I see a lack of general science knowledge in students. The connection of ideas or known facts seems to be lost and therefore higher learning cannot be achieved." Another participant made a comment in regard to feeling discouraged by stating that,

> Many times they [students with special needs] do not understand what the worksheet or test is asking for, or they get it in their head that science is hard and give up. I try to give them a lot of encouragement and present lessons in a variety of ways and if necessary give them some one on one attention.

The majority of students with special needs struggle in the biology class and show the lack of motivation to learn. This struggle manifests itself as their disruptive behavior, inability to complete assignments, and inability to retain presented concepts. To improve student engagement and understanding of the material, the biology teachers should

present lessons in different ways, model the assigned activity, or provide a concrete example of how to do the assignments. If students are having difficulty with retention of the learned concepts, the teacher should often repeat and simplify the learned concepts. In addition, the teacher should provide the students with one-on-one attention during or after the class.

Research Question 2

What obstacles/challenges do biology teachers face in instructing students with special needs?

Core Category – Requirements for Successful Inclusion

Most of the participants supported inclusion as long as certain conditions are met. They expressed the importance of support provided by the special education teacher. They felt that they need the expertise and guidance of a special education teacher to modify teaching materials and lesson plans. This need of support is evident in one of the comments, "I would need a clear plan for the student laid out and to teach them with a person who is qualified to make the appropriate modifications." The participants also reported that special education teachers have to be highly qualified, practice co-teaching, have manageable case loads and be familiar with the subject area. A few participants were confident in implementing successful inclusion as long as they receive the updated IEPs. Another major factor reported by all of the participants that influenced success of inclusion was class size and the number of students with special needs present in the inclusion setting. One participant commented,

> Really the only thing that I think could help with teaching students with special needs in inclusion classrooms is smaller class sizes and a lower percentage of

> students with special needs. This is obviously expensive and our society has consistently shown that educating poor minority kids is not a priority. Until this changes I don't think that any supports can make a difference.

It is interesting to note how one of the participants felt that successful inclusion does not only depend on support for the teacher and for the student but the support also comes from the student. The participant commented that, "The most important support comes from the student." This means that students with special needs should collaborate with the biology teacher and the special education teacher by communicating with them about the teaching aids and strategies that the student finds most effective in learning. Based on these findings, students should also be involved in their education and their input is important for the teachers in order to address their special needs. This finding is also supported by another comment, "This is where [regular classroom] students really learn to make adaptations for their disability." In other words, students with special needs are also able to determine how they learn and what tools or help they need from their teachers to achieve their full academic potential. The majority of the participants also expected parents to be supportive and involved in their child's education. On the other hand, only one participant felt that support should come from the administration.

The findings suggest that inclusion is supported in theory – that is, the biology teachers believed that students with special needs benefit in the inclusion context. In so doing, the students have the opportunity to interact with other students socially and academically. However in practice, its success depends mainly on a small class size and small number of special needs students enrolled in regular biology. The teachers need support, from the special education teachers, students, and their parents. The regular

biology teachers are sensitive and aware of the demands placed on the special education teachers as evident in the comments about their caseloads. To be effective, special education teachers need manageable caseloads and they should be familiar with the subject matter. This might be difficult to accomplish when a single special education teacher is expected to work with students and their teachers in different subject areas simultaneously.

Core Category – Challenges/Obstacles in Learning Biology

The findings from this category indicate that the challenges come from the students' lack of reading comprehension, motivation to learn, and the lack of critical thinking skills, and students' inability to retain and apply learned biological concepts as also reported in chapter 4. These challenges are evident in one of the participants' comments, who stated that "Literacy and the lack of academic skills are the biggest challenges." Other challenges and obstacles the teachers are faced with are the large class size, the lack of time and the difficulty in modifying lessons and teaching materials. These challenges are compounded with individualized learning styles, disabilities, and academic deficiencies. The veteran teacher indicated the challenges faced by stating, "They [students] are motivated by different factors, respond to teachers in different ways, struggle with different concepts and skills. They also have their own unique set of strengths and abilities. The challenge, therefore, lies in reaching each different student." These findings illustrate the challenges of being an effective biology teacher in an inclusive setting, as every student with and without disabilities is unique and has different academic needs. Reaching every student is even more challenging when there are too

many students in the classroom and the teacher is struggling with modifying teaching materials.

Core Category – Skills and Training for Teachers

The findings for this core category indicate that the majority of the participants do not feel well prepared to instruct students with special needs. They took only one course in the area of special education as a requirement for teacher certification. Once they became practitioners in the field of education they were exposed to many professional development workshops that address special needs in general. While the majority welcomed more training they reported the need for more tailored professional development or training that addresses specific subject, topic, disability, and modification of teaching materials/lesson plans. The need for specific training is evident in the following comment, "I would really like training on how to help students with reading and writing: note-taking skills, comprehension, summarizing." Still another participant recommended involvement of the special education teacher in the following way: "Special education teachers could provide real cases/scenarios about students with special needs to the regular education teachers, who would analyze the situation and then discuss how to handle each case/scenario."

Several participants felt that they have adequate skills and were not interested in more training but in smaller class size and teacher support, as reflected in the following comment,

> I feel that I have the skills that I need for the most part. There are some types of disabilities that I am not familiar with but I'm confident that I can be successful with all students if I have reasonably small class sizes, freedom to be creative and adequate resources.

Still other participants relied on the use of IEPs (Individualized Education Plans), IEP meetings, and meetings with special education teachers. As one stated, "The best training I have received has been self-sought out from meetings with special education teachers and IEP meetings."

The findings from this category inform the vendors of professional development in regards to the type of professional development they provide for the biology teachers. The teachers seek out professional development that is specifically tailored to address the disability and the effective strategies to be employed when teaching specific topics in inclusive biology. Also, some schools of education should revisit their curriculum to address the need of providing new educators with tools to assist them in working with students with special needs. So far, providing one course in the field of special education is not adequate and of minimal help. These regular biology teachers felt unprepared to teach in inclusion context.

Research Question 3

What strategies do high school biology teachers use to teach students with special needs?

Core Category – Effective Teaching Strategies

Findings from this category suggest that teachers consider students' differing learning styles and learning deficiencies when planning lessons as supported by findings in chapter 4. The teachers learned about students' learning styles and deficiencies during class discussions, one-on-one interactions, and/or individualized tutoring. Some students learned material better when the teacher provided graphic organizers, oral directions, conducted a class discussion while others respond better when students work in small

groups, and/or participate in hands-on activities. The biology teachers monitored student engagement and assessed students' progress on a daily and weekly basis and provided prompt feedback and guidance for improvement. For the most part, participants used the same teaching strategies to instruct students with and without special needs, with a few exceptions. One participant reported giving students with special needs more time to complete their work, and stated, "I use the same methods with all students, but try to give the students with special needs as much additional time as I am able to." Another person reported that "Some students with special needs would need a bit more probing, positive feedback with specific indications, and keeping him/her on task." Still another participant reported that, "The difference between students with special needs and those without is that more detail is required for students without special needs."

Among the many teaching strategies reported, the most widely used strategies were graphic organizers such as visual aids, diagrams, and flowcharts along with frequent repetitions of concepts. These findings arose from chapter 4. One of the participants stated, "Graphic organizers are used to organize key information and concepts based on similarities and differences. The Venn diagram is often used because it lends itself to science concepts that require comparing and contrasting." Many participants found repetition as a successful strategy with students with special needs. One stated, "I find that they need practice time to solidify concepts."

Participants have also implemented small group activities, role-play, laboratories, game reviews, analogies, modeled activities, and one-on-one teacher/student interactions. The usefulness of the interactions is explained in chapter 4. The group activities allow

the teachers to pair students based on their strengths, needs, and motivation. A few of the participants reported the use of analogies when explaining new concepts. One commented that the use of analogies helps students "understand and adapt the material more quickly and at a level comprehensible to them."

The implementation and effectiveness of laboratories (that apply scientific method) in inclusive biology was viewed differently. Only one participant reported that laboratories are effective while another participant finds laboratories and hands on activities not very effective. One participant stated that hands on activities are time consuming "but the students would usually be more involved". The majority did not use these strategies due to time constraints and students' lack of literacy skills. Ideally, students should be able to read, follow, and execute presented directions on their own. It was also challenging for the teacher to assign small-scale laboratories especially when class size was large and the teacher does not have an assigned special education teacher to assist the students. Theses challenges shed less favorable light on implementation of laboratories in inclusive biology context. Thus, one may conclude that indeed having students with special needs participate and perform small-scale laboratories/experiments is not effective. This is something that could be researched in the future.

Findings show that participants provided students with flashcards, note printouts and study guides to help students learn biology. Participants' comments are reported in chapter 4. They also offered individualized tutoring to find out more about students' academic deficiencies and helped the students understand biological concepts. They practiced peer tutoring by pairing academically stronger students with students with

special needs. During the lesson delivery participants also reported the use of informal class discussions. One veteran teacher reported,

> I find students with special needs participate a lot in class discussion and are engaged in a discussion format that involves processing information by listening and verbalizing it. However, I find that these students do not engage and master the material as successfully when they have to read it on their own.

Many participants found the use of activating prior knowledge and relating it to current concepts effective. For example one teacher commented,

> I have them identify by discussing or make a list of all the things they know about the topic(s). In so doing, I can build on what they already know and also eradicate any misconceptions that they might have about the concept(s).

Parental involvement was also recommended.

The findings indicate that high school biology teachers implement the same instructional strategies to teach students with and without special needs. However, students with special needs receive more guidance, time, and sometimes are expected to do less when answering questions. The teachers reported the use of graphic organizers and study aids for the most part, while a few did not find participation in laboratories and hands-on activities effective.

Core Category – Classroom Management Strategies

The findings for this category suggested that there are behavioral and instructional strategies used to manage inclusive biology classrooms. The majority reported that the class rules should not be only established but also enforced. Also, all of the participants found respect as the paramount factor in classroom management, as one stated, "Without mutual respect for the student-teacher relationship, a conducive atmosphere for learning can never exist." In fact, disregarding a misbehavior is viewed to be disrespectful, as

one noted, “if you don’t correct bad behavior it shows that you don’t expect good behavior from your students, which is a sign of disrespect.”

The participants have also recommended implementation of routine class procedures to provide structure for the students so they know what to expect. For example, one commented that

> At the start of each class period students are required to complete a warm up activity. This is generally used to set the tone for the topic or concepts to be covered during the period. Also, the objectives for the lesson as well as any assignments for the period are outlined on the board. These serve as a guide so students will know what they are required to do.

The participants also find conferences between students and/or their parents effective as well. One of the participants commented, “Meeting with parents or students before or after class in a confidential setting can provide better understanding of any gaps or problems the specific student may be having.”

Instructional strategies have also helped biology teachers in managing their classroom effectively. The teachers of this study reported that staying organized and teaching students to stay organized is helpful in classroom management. Some teachers reported the use of binders for organizational purposes. One mentioned that having all students keep an organized binder:

> …allows students to help each other and keep all of the classes at the same spot in the curriculum. This also greatly helps the special education department, especially when teachers are not inclusive but interact with students solely in resource.

Teachers also felt that students should be engaged in meaningful learning at all times. In fact, one participant reported that “Keeping students on task at all times helps to maintain classroom atmosphere that is conducive for learning.” In so doing, several participants

reported implementation of a peer teaching approach, grouping students in accordance to their motivation and ability levels, small group discussions, and teacher-student one-on-one interaction.

In general, the study indicates that biology teachers look at management of an inclusive classroom from different points of view. The majority took a behavioral viewpoint and expressed that the teacher-student relationships and student-student relationships must be respectful. Also, maintaining a respectful atmosphere fosters learning and engagement in instructional activities such as group work/group discussions. The teachers find peer tutoring, tutoring provided by a teacher, and grouping stronger students with weaker ones effective as well.

Interpretation of Findings in Relation to the Body of Literature

Research Question 1

Core Category – Struggling Special Needs Students

The finding from this study indicated that students with special needs are struggling and feel discouraged when they learn biology in an inclusive setting. To lower the feelings of discouragement and struggle, Pellitteri, Dealy, Fasano, and Kugler (2006) recommended that teachers develop interventions that help students regulate their learning and emotions. They claimed that doing so would improve students' motivation to learn, social relations, information processing, and cognitive organization.

This study's results suggest that the participants do not have self-regulation interventions in place. Thus, it is recommended that biology teachers collaborate with special

education teachers to develop such interventions, since they benefit student emotions and learning.

Research Question 2

Core Category – Requirements for Successful Inclusion and Challenges in Learning Biology

High school biology teachers in this study expressed a conditional support of inclusion. This indicates that these participants have experienced and formed their position in regard to inclusion. The literature shows that many teachers have negative attitudes or feel uncertain about inclusion because they were uncertain about the benefits inclusion provides for the students and they experienced the lack of collaboration between general education teachers and special education teachers (Hammond & Ingalls, 2003). The findings from this current study indicate that general education teachers need support from special education teachers. In fact, they expect the teachers to be highly qualified, practice co-teaching, know the subject area, and have manageable caseloads. Another major factor is small class size and a small percentage of students with special needs in the inclusive setting. These findings are supported by Burstein, Sears, Wilcoxen, Cabello, and Spagna (2004) and Talmor, Reiter, and Feigin (2005) studies which concluded that teachers need a smaller workload and smaller number of students with special needs and assistance; otherwise they will experience burnout and feel less effective in implementing inclusion.

In this study biology teachers also reported the need of support coming from the students with special needs themselves. The inclusion setting should help them develop

adaptations for their disability. This finding is consistent with findings from Curtin and Clarke (2005), who reported that students with special needs should take part in determining the type of accommodation they need to be successful in a regular classroom. Similarly, Kortering, deBettencourt, and Braziel (2005) pointed out that students with special needs should be allowed to participate in the development of their IEPs (Individual Education Programs).

Core Category – Skills and Training for Teachers

The majority of the biology teachers in this study reported that they did not feel well prepared in implementing inclusion even though they took one course that related to special education before they entered the education workforce. These current findings contradict the findings of Lambert, Curran, Prigge, and Shorr (2005), which showed that pre-service teachers felt more prepared and confident to teach students with special needs in a regular classroom after they took an introductory inclusion course.

Research Question 3

Core Category – Effective Teaching Strategies

In this study participants reported the use of the same instructional strategies when teaching students with and without special needs. They found that both groups benefit equally from such an approach. During instruction delivery they used graphic organizers and provided students with study aids like notes or flashcards. They found these methods effective in implementing biology inclusion. These results are supported by Friend and Bursuck (1999), who stated that instructional adaptations should benefit all students in the classroom since students learn in different ways.

While the same strategies are implemented in the inclusive classroom, the participants reported that students with special needs receive more guidance, time, are required to answer a reduced number of questions or are required to provide less detail. Furthermore, they implement individualized tutoring, peer tutoring, and group work where they pair academically stronger students with students with special needs. These findings are similar to previous work showing that students with special needs are more successful when teachers use instructional accommodations (such as color coding, peer tutoring, cross-age tutoring, calculators, extended time to complete work, and reading questions to students) and assessment accommodations (such as reduced number of test questions and use of concrete objects and cue cards) (Maccini & Gagnon, 2006).

The perpetual cycle of improvement framework was developed in the pilot study and it grounds this study as presented below. This framework allows readers to review its parts and have a clear understanding of how it is further developed as presented in the new model.

Interpretation of Findings in Relation to the Conceptual Framework

The goal of this study is to develop a substantive model that depicts the effective strategies used by high school biology teachers to instruct students with special needs in an inclusion context. The findings of this research study have generated a substantive model that is specific to effective approaches for teaching biology in inclusive classrooms. This new model has some similarities to the perpetual cycle of improvement model since both models consider teaching strategies and classroom management strategies based on teachers' perspectives. In addition, the new model builds on the

perpetual cycle of improvement framework by adding skills and training for teachers, elements that promote development of academic abilities, and student abilities.

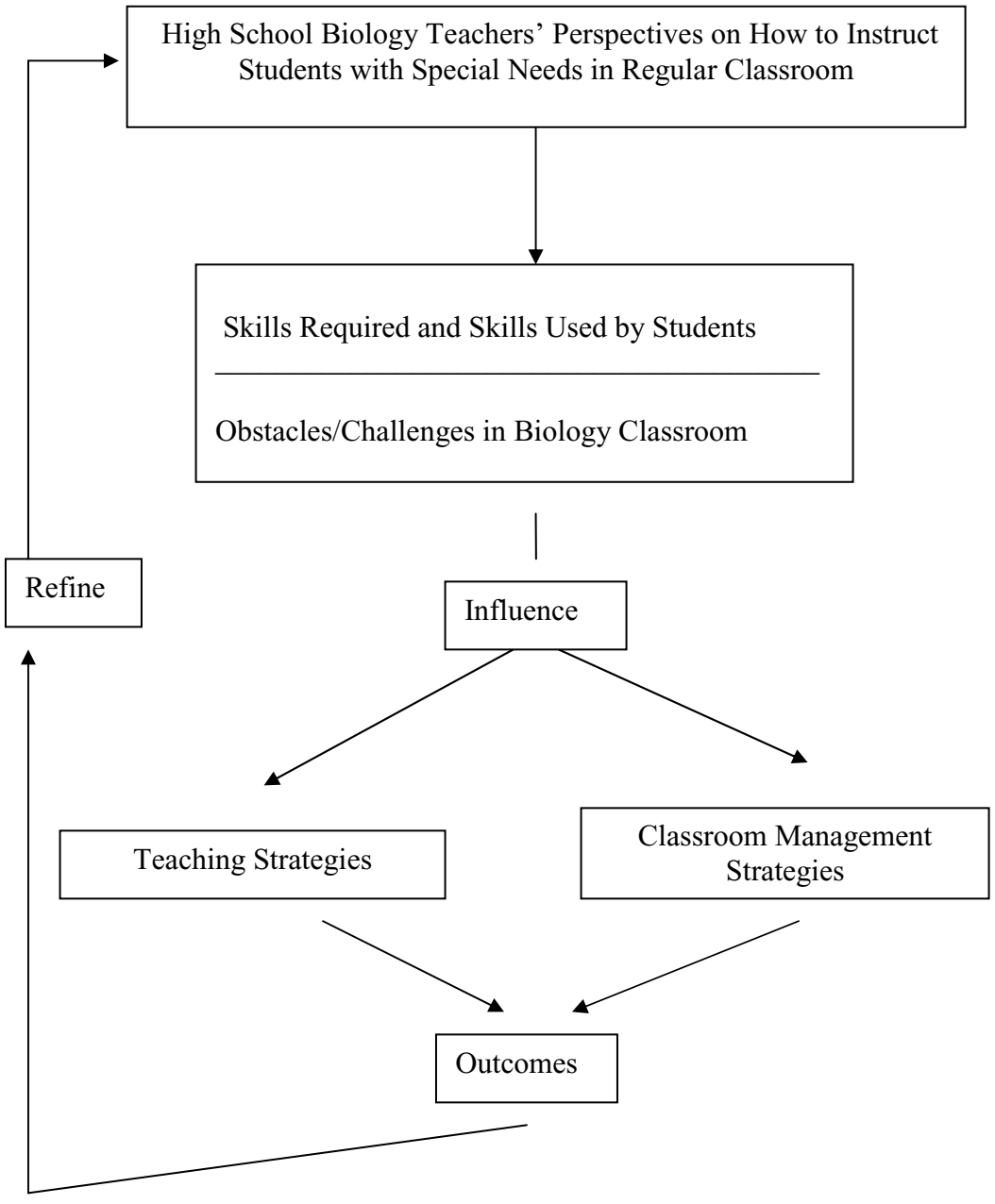

Figure 1. Perpetual cycle of improvement

Model Depicting Effective Approaches for Teaching Biology

Development of the Model

This model was developed from data collected from high school biology teachers who teach in one of the public school districts in the Midwestern United States. The model includes information that the participants of the study shared based on their teaching experience in regard to effective approaches they use to instruct students in an inclusion setting. The information was gathered through phone interviews.

Description of the Model (Figure 4)

This model consists of nine major elements that are important to the implementation and understanding of the model. The major elements in Figure 4 are:

1. Skills and Training for Teachers
2. Specific Teaching Strategies Used
3. Successful Classroom Management Strategies
4. Qualified/Supportive Special Education Teachers
5. Parental Support
6. Motivated Students
7. Small Class Size
8. Lower Percentages of Students with Special Needs in Inclusive Classroom
9. Students' Abilities

The model is inductive and its ultimate intent is to promote students' abilities.

Current and future teachers who intend to use this model must read the different elements of the model simultaneously with the description of the model for it includes

specific examples for some of the subcategories and their relationships. A brief description of all the elements is given to provide the guidelines.

Adequate skills and training for teachers will positively influence the specific teaching strategies teachers use and the classroom management strategies implemented. In turn, the successful teaching strategies and the classroom management strategies will promote students' abilities. Students' abilities are also influenced by the availability of a qualified and supportive special education teacher, parental support, motivation, small class size, and lower percentage of students with special needs in the inclusive classroom.

Skills and Training for Teachers

The teachers in this study did not feel well prepared to teach students with and without special needs in a regular biology classroom. This is the result of the pre-service training and workshops/professional development they have experienced. For the most part teachers took one pre-service course that related to special education as well as many workshops and professional developments. To improve inclusive instruction biology teachers expressed the need for subject specific, topic specific, and disability specific training. Teachers also need updated IEPs to be distributed to biology teachers in a timely manner so they can use them to adequately address the academic needs of their students with special needs. They also should attend IEP meetings to improve their instruction.

Specific Teaching Strategies Used

High school biology teachers employ many strategies that they find effective in implementing inclusion. They plan lessons in accordance with students' special needs

and different learning styles. They use interactive methods, such as small group activities, role play, game reviews, and analogies to provide concrete examples and explanations for new concepts. They model activities to provide guidance, and interact with students one-on-one to find out the source of their struggle or deficiencies. The teachers use graphic organizers such as visual aids, diagrams, and flow charts to help students learn new concepts. They provide students with study aids such as note-print outs, study guides, and flashcards. They assess students more often by practicing daily end-of-class quizzes, weekly exams instead of chapter exams, and provide prompt feedback. During lesson delivery teachers relate prior knowledge to current topics, they break up concepts into small and relatable bits of facts, they repeat fundamental concepts presented, use relevant articles to improve understanding of the concepts, practice informal class discussions, and would like parents to be involved in their child's learning.

Successful Classroom Management Strategies

This model consists of two major classroom management strategies: behavioral and instructional. Implementation of these types of strategies ensures that students are on task and engaged in learning. The behavioral strategies include establishment and enforcement of class rules, maintaining of a respectful atmosphere among students and their teacher. The respectful atmosphere is also maintained when teachers correct inappropriate behavior. Another strategy is the scheduling of conferences among teacher, student, and parent to discuss behavioral or academic needs. Establishment and implementation of routine class procedures is also important so the students understand what is expected of them and when it should be done. For example, teachers begin the

lesson with a bell ringer, have lesson objectives and homework posted on the board, and end the lesson with an assessment.

The instructional classroom management strategies include organization on the part of the teacher and the student. Teachers should be organized during lesson delivery/instruction and their students should also stay organized by using a binder where they keep their notes, class work, assignments, and assessments. Another strategy the teachers use is peer teaching. They select an academically stronger student to teach a student who is academically weaker. They also implement small group discussions and group activities. During the group activities students are grouped together in terms of motivational and ability levels. Another strategy is a teacher-student one-on-one interaction, which allows the teacher to determine and address any academic deficiencies the student may have. Keeping students engaged at all times is another strategy teachers employ to manage their classrooms. However, students should be engaged in activities that are meaningful.

Qualified/Supportive Special Education Teachers

To implement inclusion successfully and thus to promote students' academic skills and abilities, biology teachers require support and collaboration of a special education teacher who is highly qualified. The highly qualified special education teacher should practice co-teaching or at least be available for the biology teachers and their students. Furthermore, the special education teachers should have a manageable case load and be familiar with the subject matter. Thus, the special education teachers should be selected according to their subject knowledge and then assigned to work with a

subject-specific regular education teacher. These teachers should provide support to regular biology teachers by helping and or training teachers on how to modify lesson plans, teaching materials, and providing updated IEPs (Individual Education Plans) at the start of the school year.

Parental Support

Parental support in their child's education fosters the development of academic abilities. This support is evident when parent(s) communicate with teachers and their child through conferences, phone conversations, and IEP meetings. At the meeting all of the parties report on the student's progress and the means of improvement. Teachers, however, have no control over the degree of parental involvement.

Motivated Students

Motivation is another important element necessary for the development of academic abilities of students with special needs. Motivating students in an inclusion context is difficult since many students with special needs feel discouraged, lack higher learning achievement, and need more time to complete the work. The struggle and thus the lack of motivation are compounded by poor literacy skills and organizational skills such as time allocation, scheduling of tasks, and inability to organize information.

Small Class Size

Class size is another factor that ensures success of inclusion and development of necessary student abilities to learn biology. Overall, teachers need a small class size to reach every student. In addition, they value small class size the most in comparison to training and support coming from special education teachers.

Lower Percentage of Students with Special Needs in Inclusive Classroom

A lower percentage of students with special needs in inclusion classrooms also promotes the development of students' abilities for mastering biology concepts. Doing so allows the teacher to provide the student with the necessary attention. A large class size and the high number of students with special needs in regular biology make teachers (both regular education and special education) feel overwhelmed and ineffective. Thus, providing a special education teacher alone is not effective.

Students' Abilities

The teaching strategies, classroom management strategies, provision of qualified and supportive special education teachers, parental support, motivated students, small class size, and the lower percentage of students with special needs in regular biology contribute to the development of abilities students with and without special needs should possess in order to successfully learn biology concepts. In successful inclusion students with and without special needs should be able to develop and comprehend graphic organizers such as visual aids, diagrams, and flowcharts. Students should also become proficient in literacy, that is, they should be able to read, write, take notes, think critically, and follow instructions. In order to achieve higher learning, it is also important that the students are able to relate current knowledge to previous knowledge. They should also be able to participate in hands-on activities and perform basic calculations when necessary.

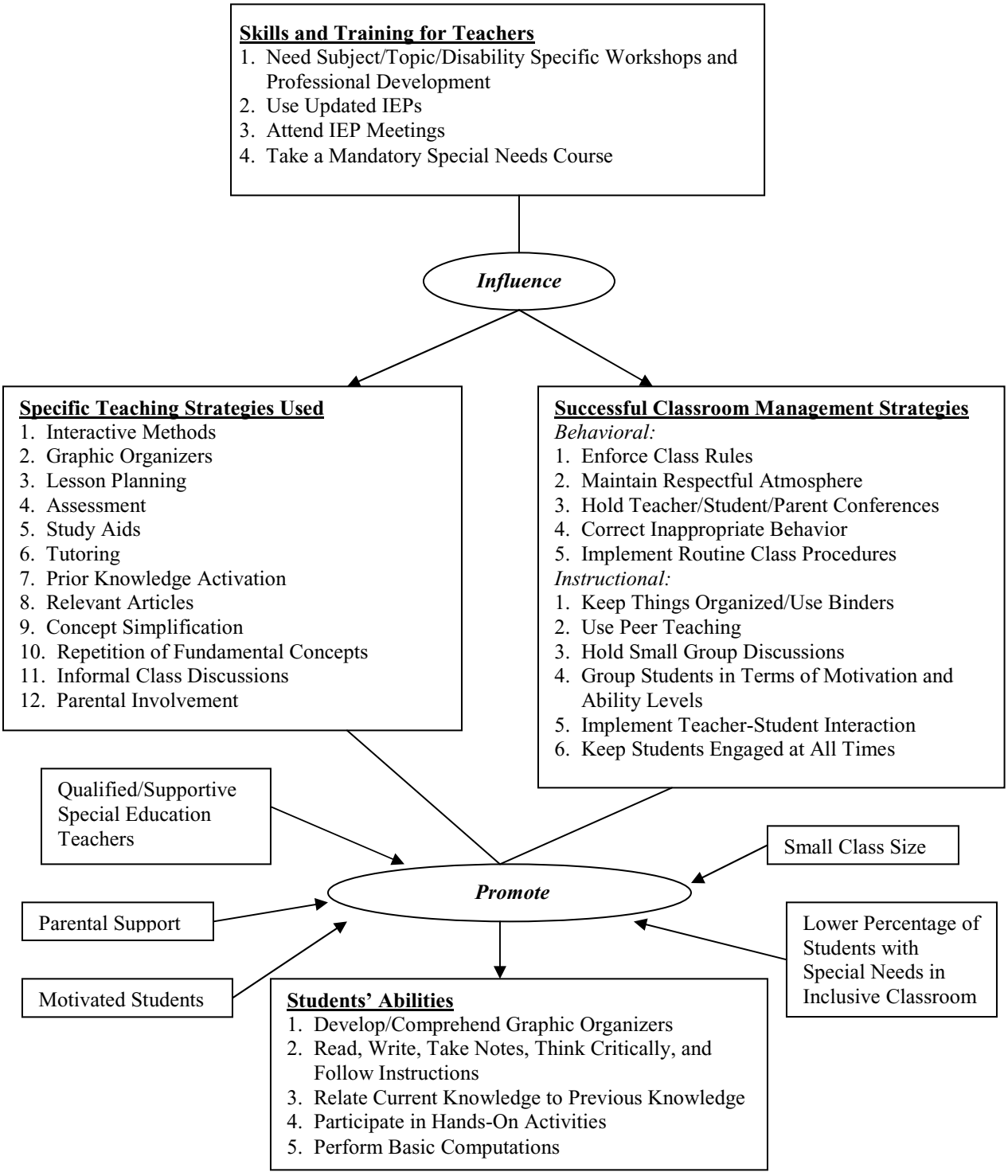

Figure 4. Effective Approaches for Teaching Biology in Inclusive Classrooms

Summary of Conclusions

The research confirms that the effectiveness of instructional approaches depends on the skills teachers possess and their training before and during their teaching career. Limiting secondary educators to a single course relating to special education while they earn their teaching certificate is not adequate. Furthermore, the data generated from this study indicate that teachers require training or professional development that is closely tailored to the topic they teach, subject, and student disabilities.

The training and the skills teachers have influence their practice and effectiveness in an inclusion context. When implementing inclusion, biology teachers use a variety of instructional strategies and classroom management strategies that equally benefit students with and without special needs. The variety of strategies used address students' special needs and learning styles. Evidence from the participants of this study also indicate that students with special needs are given more time to complete their work, receive positive feedback and are required to provide less detail when answering questions.

The effective instructional and classroom management strategies provided in the model, along with supportive and qualified special education teachers and parents, promote successful inclusion. Successful inclusion takes place when students' academic abilities are developed and lead to the mastering of biological concepts. The data from this study also indicate other factors that contribute to the development of students' abilities such as motivated students, small class size, and the smaller number of students with special needs in the inclusion context. The model serves as a tool that high school biology teachers should implement to become more effective inclusion practitioners.

Implications for Social Change

Practicing and implementing effective instructional strategies in an inclusion setting is important in the field of education. Preparation of high school biology teachers before they enter the teaching career and during their practice is not sufficient. Teachers still require more quality training that is tailored to their specific needs in order to address the essential and effective instructional strategies to teach students with and without special needs in regular biology classrooms. The significance of this study is the development of a substantive model that provides effective teaching approaches that high school biology teachers may use to implement inclusion. Chapter 5 presented the outcome of this study, which is a model that depicts effective approaches for teaching biology in an inclusive classroom.

This model has several implications for social change. The first major implication is that the model serves to provide high school biology teachers with effective approaches employed to instruct students with and without special needs and the factors that influence success of their implementation. The approaches will improve biology instruction in an inclusion setting. The second implication is that both groups, students with and students without special needs, will improve their learning when biology teachers implement the strategies provided in the model. The third implication is that the model supports the primary goal of education advocated by policy makers, which is to provide high quality education to all students. Lastly, the model provides professional developers and college educators with approaches that address teachers' needs that lead to improvement of instruction of students with and without special needs.

Recommendations for Action

High school biology teachers, special education teachers, other high school science teachers, school administrators, and professional developers are the targeted audience for the results of this study. It is recommended that school administrators (principals and/or assistant principals) request a meeting and collaboration between biology specialists and special education specialists to examine the model and implement it on a small scale to determine its effectiveness. The effectiveness of the model could be identified through examination of students' achievement records of the teachers who implemented the model. Students' achievement records should be examined before and after implementation of the model. If the model demonstrates its effectiveness, then it should be disseminated to other science teachers through professional development.

The model and its description could be forwarded to the chairperson in the science education department and special education department for different school districts, colleges, and universities that offer programs and training for future biology teachers, science teachers, and even special education teachers. The model could be also presented and disseminated at annual symposia and professional conferences. Teachers at departmental meetings could also benefit from its presentation.

Recommendations for Future Research

In this study the literature review indicated that many studies have been done on science teaching through implementation of science inquiry, attitudes towards inclusion, and many instructional strategies that could be used by biology teachers or science teachers. The data generated from this study revealed the high school biology teachers'

perspectives on strategies they employ in an inclusion context. This study generates new questions: Why is science inquiry not implemented by biology teachers in an inclusive classroom? What specific teaching strategies are more effective to use with students with and without special needs to improve their learning of biology? What classroom management strategies are more effective when implementing inclusion in biology classrooms?

The following are related topics for future studies:

1. Grounded theory study or a case study focusing on science inquiry implementation in an inclusion context.
2. Quantitative research study on student achievement before and after an instructional strategy is implemented in the inclusion setting.
3. Quantitative research study on student achievement before and after classroom management strategies are implemented in an inclusion setting.
4. Quantitative research study and qualitative studies that examine the effectiveness of the strategies generated from this study across other sciences.
5. Repetition of this current study with a larger population of high school biology teachers.
6. Quantitative research study and qualitative research study that examines the effectiveness and implementation of small-scale laboratories/experiments in a science classroom.

The Researcher's Reflection on the Experience with the Research Process

The research process was time-consuming, frustrating, but rewarding in the end. It required self-discipline, motivation, patience, and a lot of support from mentors, family, friends, and colleagues. This research process reminds me of metamorphosis. In the beginning I selected a topic that was too broad and had to be narrowed down. The basic skeleton of the research study with the narrowed topic was reflected in the prospectus that changed its form as the research continued. Identifying a conceptual framework and the method of data collection for this study was a challenge and it unfolded, like a metamorphosis, as the proposal was completed and data collection begun.

I work in an urban school setting as a biology teacher and recognize that I entered this study with several assumptions. The first assumption stems from my teaching experience, that led me to reason that science teachers struggle when inclusion is implemented. Another assumption that I hold is that urban classrooms are overcrowded and are faced with more challenges as opposed to suburban and rural school settings. The last assumption relates to services provided for students with special needs. I believe that students with special needs receive better services that address their needs and that parents are more supportive in suburbs and rural areas.

While conducting phone interviews I did not impose my personal opinions or recommendations in regard to the strategies that I find effective. I distanced my points of view by confirming my biases with the peer reviewer and by keeping a reflective journal to separate my views from the emerged data. To keep objectivity, I also maintained a

skeptical attitude when categories emerged, and I went back repeatedly to validate them with the actual data. Following the methodology procedures for data analysis was also helpful in keeping me from personal biases.

Closing Statement

Effective approaches for teaching biology in an inclusive classroom model will help to improve instructional practices and learning of biology concepts. This model will help not only high school biology teachers but also other science teachers, professional developers, and educators from higher learning institutions. The model is formed based on high school biology teachers' perspectives, experiences, and practices and provides guidance for implementation of inclusion in a regular setting. Its elements indicate the teachers' skills and training influence instructional and classroom management strategies that are necessary for implementation of successful inclusion. Other elements that also influence and promote successful inclusion, and thus foster development of students' academic abilities include; qualified and supportive special education teachers, parental support, motivated students, small class size, and a small number of students with special needs in an inclusion classroom.

Previous research studies did not address the needs of high school biology teachers who are faced with the challenges when implementing inclusion. This model serves as a guidance and communication tool for biology teachers and other science teachers who are actively engaged in improving their skills and practice to teach biology concepts to students with and without special needs in the same context. These students will also benefit from this model when their teachers implement the different strategies,

for they address not only special needs but also different learning styles. This model should help students with special needs to feel accepted, learn to function with their peers and society as they grow up, and to become more scientifically literate adults.

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Appendix A: Interview Questionnaire for High School Biology Teachers in Regard to Perspectives on Effective Approaches Teaching Biology to Students with Special Needs

Designed by Agnieszka Kos

1. What skills do you think students with special needs should use to help them understand biology concepts?

2. What are the skills students use to learn biology concepts?

3. Have you observed students with special needs struggling in your biology class as they work on class work (assignments/projects/assessments etc.)? Provide an explanation. (Probes: If so, please describe, generally, what you have observed)

4. Do you support inclusion? (Probe: Why or why not)

5. What kind of support do you need to be more effective in instructing students with special needs in a regular biology classroom? (Probes: Support from administrators? Fellow instructors? Staff and specialized instructors?)

6. What is the main challenge or obstacle when you teach students with and without special needs?

7. Do you believe you have enough skills/training to deal with students with special needs in regular classroom? (Probes: why or why not? What type of skills or training do you think would be necessary to enhance your work with special needs students? What skills/training do you currently have that serves you well?)

8. What pre-service training did you receive or staff development did you receive to help you working with students with special needs?

9. What training or staff development do you feel would be the most beneficial to you?

10. What strategies do you find effective in teaching biology to students with special needs? (Probes: what specific approaches do you use with these students that work well?)

11. Do you use the same strategies to teach students with and without special needs? (Probe: tell me about these strategies and how they are the same or different)

12. What strategies do you use to manage your inclusive classroom? Probe/explanation: what do you do to maintain a classroom atmosphere that is conducive to learning? (respectful, orderly, positive, etc.)

Appendix B: Sample Memo

High School Teachers' Perspectives on Effective Approaches for Teaching Biology to Students with Special Needs

June 11, 2009

This sample memo consists of code notes, notes about the meaning of the codes, and reflection notes about analyzed data. This memo shows my initial abstract thinking about the data from an interview transcript.

Reflections/notes based on interview transcription dated **6/11/09** from **participant B**
Addressing research question #1
The following concepts were identified during the first reading of the first three responses (they address research question #1) to the interview questionnaire:
Visual skills
Audio skills
Hands-on skills
Lack of communication
Improper lesson delivery

I think this participant is saying that students with special needs should be able to read and understand visuals like diagrams, figures etc. Also, they need to be good listeners and be able to participate in hands-on activities. These skills should be and are used by all students. The success in understanding of biology concepts also depends on the teacher and his/her lesson delivery and proper communication of the lessons' goals and expectations.

This teacher feels that it is necessary for the teacher to cover the material first and then follow with reinforcing activities and assignments. This, from my experience, is true for students with special needs but others should be able to do the work without thorough preparation or material coverage. It seems that the skills necessary to learn biology overlap somewhat with the skills that some special needs students use. I need to pay attention for similarities in the skills and wonder how many participants share the need for the same skills. I also will need to look for relationship between the skills students use and their struggle in learning. If there is a struggle in grasping concepts due to limited skills then the lesson should be modified? I wonder how to organize the categories? How about quotes that support the categories?

Research Question #2, Interview Transcription 6/11/09
The following concepts were identified during the first reading of the responses to question # 4, 5, 6, 7, 8, and 9 in the interview questionnaire:

Conditional support of inclusion

Time constraints
Lack of qualifications
Modification requirements
Class size issues
Need of qualified special needs teacher
All students don't retain presented concepts
Students struggle with application of the learned concepts
Need of subject/disability specific training
Degree specialization in special needs
Teacher certification and special education course

This participant is saying that inclusion is beneficial to students with special needs but only when class size is small and a qualified special needs teacher is present to provide lesson modifications to serve the needs of the student with special needs. The participant did not feel qualified to serve the students with special needs since only one course in special education was the requirement for teacher certification. Also the participant felt that time constraint is another factor that leads to inadequate instruction (having higher vs. lower expectations and level of education) for students with and without disabilities. The participant believes that one needs to specialize in special education to be most effective. Also, administration should provide subject, disability, and grade level specific training. The participant finds teaching new concepts difficult because all students have problems retaining what was presented and applying the learned concepts in other situations (class assignments, projects etc.).

I am curious to see how many other participants support inclusion and whether or not they stated conditions. It seems that the participant is struggling in instructing all students in biology classroom. I would definitely agree with the participant, inclusion is a desirable context but there are conditions that need to be met to "run" class smoothly and effectively.

Research Question #3, Interview Transcription 6/11/09
The following concepts were identified during the first reading of the responses to question # 10, 11, and 12 in the interview questionnaire:

Role-play
Laboratories
Note printouts
Study guides
Game reviews
Visual aids
Use of same strategies benefits all students
Post class rules
Enforce the rules

This participant uses a variety of strategies that serve well students with and without special needs in learning biology such as role-play, laboratories, note printouts, study guides, game reviews and visual aids. To manage such a diverse classroom the participant posts and consistently enforces class rules that provide students with a sense of security.

The different strategies are more likely to engage more students but they may have a preference of one strategy over another. I wonder if other participants find laboratories effective as well. From my experience I recall that conducting laboratories is frustrating because students do not read directions and need to be "spoon-fed". Class management is definitely important to provide a secure learning environment.

As core categories emerged I wondered whether they were too broad or too specific. They emerged from the questions from the interview questionnaire. I need to discuss this with peer reviewer. I went through each response and looked for comments that correspond to the core categories. Sometimes this was confusing since parts of comments overlapped but still other parts were different. For now I decided to leave them as is and then decide how to reduce them. Also, I wonder how these categories and comments should be organized. I think a table will be sufficient.

Appendix C: Audit Trail Steps

High School Teachers' Perspectives on Effective Approaches for Teaching Biology to Students with Special Needs.
Walden University 2009

The information below provides an outline of audit trail steps taken to analyze the semi-structured phone interview data.

I. Data Collection Process
Phone Interviews

A. Recruited potential participants via listserv and email.
B. Sent interview questionnaire and the consent form to the participant(s).
C. Scheduled individual interview(s) with teacher participants: June 4-June 30, 2009.
D. Transcribed interview(s).
E. The questionnaires were letter coded to keep participants' names confidential.
F. Transcripts/draft responses were reviewed for accuracy, clarity, and possible follow up questions.
G. Contacted interview participants for a follow-up phone interview if additional information was needed: June 4-June 30, 2009.
H. Member checks were performed by/with each participant.

II. Data Analysis

A. Read the interview transcript
B. Wrote initial abstract thinking about data in reflective journal.
C. Identified core categories that correspond to each research question through line-by-line analysis during open coding.
D. Typed the emerging core categories and typical comments and saved them in Microsoft Word under "data coding" file.
E. Wrote thoughts and questions that pertained to the core categories and the typical comments in reflective journal and the margins of the transcript.
F. Reread the interview transcripts data to ensure that no data were missing during the first reading.
G. Read the interview transcript again line-by-line and recorded subcategories below core categories in the "data coding" file.
H. Reviewed all of the core categories and subcategories.
I. Created tables to present the categories for each question and the participants' typical comments.
J. Created resulting categories and subcategories in form of an outline.
K. Created an analytical diagram from axial coding.

III. Interpretation of Data

A. Each core category was interpreted according to relevant data and corresponded to each research question.
B. Read the literature and identified findings that were consistent or inconsistent with the data from this study.
C. Reviewed the perpetual cycle of improvement model.
D. Discussed the relationship of the perpetual cycle of improvement model with the new model.
E. Described the new model.
F. Presented the new model on effective approaches for teaching biology in inclusive classroom.
G. Stated conclusion based on the findings.

IV. Data Validation

A. Met with peer reviewer to discuss emerged core categories and subcategories.
B. Submitted draft of outlined core categories and subcategories to peer reviewer.
C. Discussed outline with peer reviewer.
D. Submitted draft of the model to peer reviewer and chairperson.
E. Discussed the model with peer reviewer and chairperson.
F. Submitted draft of chapter 4 to peer reviewer to read.
G. Met with peer reviewer to discuss draft of chapter 4.
H. Considered peer review input for chapter 4 of the study.
I. Submitted draft of chapter 5 to peer reviewer to read.
J. Met with peer reviewer to discuss draft of chapter 5.
K. Considered peer review input for chapter 5 of the study.
L. Submitted chapter 4 and 5 to dissertation chair.

Appendix D: List of Codes and Research Questions

High School Teachers' Perspectives on Effective Approaches for Teaching Biology to Students with Special Needs

Question 1 – Teachers' Perspectives on Learning Biology

Visual skills
Audio skills
Hands-on skills
Lack of communication
Lesson delivery
"How to study" skills
Flashcards
Illustrations
Concept application
Prior knowledge
Hands on activities
Interactive activities
Analogies
Class disruption
Misbehavior
Off task
Reading skills
Math skills
Mathematical logic
Concept building
General science knowledge
Diagrams
Drawings
Review
Vocabulary
Reading
Glossary
Copying
Pre-reading
Engagement
Stay organized
Reading strategies
Writing strategies
Seek out help
Repetition
Visual aids
Flowcharts
Content knowledge

Analysis
Synthesis
More time
Concrete examples
Making observations
Pattern recognition
Memory
Literacy
Critical thinking
Follow directions
Persistence
Comprehension
Differentiated instruction
Read aloud
Reread over and over
Write as read
Individual specific skills
Motor skills
Cognitive issues

Question 2 – Obstacles/Challenges in Learning
Conditional support of inclusion
Time constraints
Lack of qualifications
Modification requirements
Class size issues
Qualified special education teacher
Concept retention
Concept Application issues
Specific training
Special education degree
Special education course
Teacher certification
Social skills
Adaptations
Support
Resources
Confidence booster
Feedback
Teacher support
Student support
Acceptance
Active participation

Co-teaching
Motivation
Language simplification
Teaching style
Apathy
Preparatory time
Staff development issues
Curriculum design
Home tutoring
School tutoring
Resistance to reading
Individual specific abilities
Reading and math training
Master teacher leaders
Parental involvement
Discussion of progress
Cognitive level
Resource periods
Administrative support
Time management
IEPs
IEP meetings
Assessment modification
Self directed time
Inclusion teacher overload
Team teaching
Literacy
Collaboration
Safety concerns
Proven strategies
Conferences

Question 3 – Inclusion Teaching Strategies
Role-play
Note-print-outs
Study guides
Game reviews
Visual aids
Class rules
Use same strategies
Flashcards
Instructional adaptations
Respect
Teacher/student/parent communication

Small groups
Interactive methods
Illustrative methods
Concept simplification
Repetition
Equal treatment
Analogy use
Establishment of expectations
Conferences
Identification of deficiencies
IEP issues
Patience
Courtesy
Discipline
Hands on activities
Laboratories
Graphics
Bell ringers
Attentiveness
Timely submitted assignments
Modeling
Feedback
Build confidence
Slower pace
Bad behavior
Engagement
Binders
Scaffolding
Vocabulary learning activities
Pairing students
Accommodations
Organization
Diagrams
Peer mentoring
Routine class procedures
Individualized tutoring
Class cues
Proximity
Parental involvement
Proper sitting arrangement
Probing
Positive feedback
Teamwork
Individualized attention

Teacher-students one-on-one interaction
Group discussions
Reading strategies
Note taking technique
Graphic organizers
Warm-up activity
Lesson objectives
Assignment list
Enrichment activities
Seek peer help
High expectations
Punctuality
Preparedness
Instruction review
Oral repetition of notes

Appendix E: Round 1 Sample Coding

Round 1 – Monday, June 29, 2009 8:29pm
(File J)

Demographical Data
High school biology teacher
Number of years teaching: 8 years

1. What skills do you think students with special needs should use to help them understand biology concepts?

Special need students should be able to think critically, follow basic instructions, be attentive, read, write and be persistent. For example biology is a laboratory subject; therefore it is important for students to use a combination of skills to perform lab activities. That is, listening to instructions that the teacher may provide before and during the lab, read the instructions in order to carry out the lab. Also they will need critical thinking skills to analyze and interpret data, and graphs

I wonder if this person implements labs

2. What are the skills students use to learn biology concepts?

Memorization, reading & comprehension, listening skills, studying, repetition/rote, practice, critical thinking skills. These skills are very important because science concepts often build upon on each other. Therefore, students will need to remember concepts taught in previous unit in order to apply it to the next unit. For example, students might learn about the structure of cells in a particular unit and then in a later unit they might learn about cellular transport. Having learned about cellular structure they will be able to comprehend both concepts and make the connection between

activation of prior knowledge

the two…the purpose/function of the cell membrane and what are the substance that can and cannot pass through.

3. Have you observed students with special needs struggling in your biology class as they work on class work (assignments/projects/assessments etc.)? Provide an explanation. (Probes: If so, please describe, generally what you have observed)

Yes, often times I observed special need students struggling in my biology class. For example, most special need students take longer time in completing in-class assignments, tests/quizzes projects and laboratory investigation due to poor reading and comprehension skills. For example, students who read below their grade level may not understand all of the content material and as a result they often need extra support. This often required further explanation and modification of the instructions to meet their level of understanding.

4. Do you support inclusion? (Probe: Why? or Why not?)

I firmly support inclusion of special need students in general education class provided that they are given the necessary support by their resource/special education teacher. Also, there should be ongoing collaboration between the regular education and special education teacher. Furthermore, no one should be discriminated against as a result of their disability which may due to no fault of their own. Everyone deserves a chance as well as an equal opportunity to prove him/her-self. In addition, from experience and observations, I have seen special need students out perform students without special needs.

5. What kind of support do you need to be more effective in instructing students with special needs in a regular biology classroom? (Probes: Support from administrators? Fellow instructors? Staff and specialized instructors?)

I believe that in order for me to be very effective in instructing special needs students, I need full support and cooperation of their parents and

support from Sp. ed. teacher

special education teacher on a consistent basis throughout the school year. For example, there should be clear and effective ongoing communication among all parties involved – both orally and in writing. Against this background, any short-term problems that they encounter while studying biology can be addressed in the most expedient manner. For instance, it may take several weeks and even months before receiving the IEP for a particular special need student. As a result, with the lack of such critical information, I do not know their level of reading, comprehension and computation skills, so it often poses a challenge when planning instructions. This often makes it difficult for them to grasps the concept being taught, because I cannot effectively modify instructions to meet their level of understanding.

teacher/student/parent communication

need timely IEPs

no IEP → challenges

6. What is the main challenge or obstacle when you teach students with and without special needs?

The main challenge and/or obstacle is the ability of students with and without special needs to think critically, follow basic instructions and read about the topic in question from their textbook. Since some special need students read below their grade level, this can make it difficult for them to understand content materials without some form of modification and explanation.

modification of teaching materials

7. Do you believe you have enough skills/training to deal with students with special needs in regular classroom? (Probes: Why or Why not? What type of skills or training do you think would be necessary to enhance your work with special needs students? What skills/training do you currently have that serves you well?)

willingness more training

I do not have the all the necessary skills/training to deal effectively with special needs students because I have only taken a few basic courses that deals with special need students.

8. What pre-service training did you receive or staff development did you receive to help you working with students with special needs?

I think I took two special education courses in college and received staff development on learning disability and policies in special education

9. What training or staff development do you feel would be the most beneficial to you?

I believe that a staff development that includes the collaboration of both regular and special education teachers would be very beneficial. For example, real cases/ scenario about special need students could be presented to the regular education teachers, who would analyze situation and then discuss how they would handle each case/scenario. The special education would serve as support personnel to provide guidance and feed back to the regular education.

10. What strategies do you find effective in teaching biology to students with special needs? (Probes: What specific approaches do you use with these students that work well?)

The strategies that I have used to manage inclusive students include Teacher-students one-on-one interactions, small group discussions, allowing them to work in groups with students who are highly self-motivated. Having one-on-one interaction with special need students, I am able to find out specifically what problems they are having…which often times range from difficulty understanding key scientific terms used in text to completing assignments. Through teacher-student interaction, I am able to provide feedback and clarification, which help the student complete the assignment and comprehend the key scientific terms.

11. Do you use the same strategies to teach students with and without special needs? (Probe: Tell me about these strategies and how they are the same or different)

I used some of the same strategies to teach students with and without special needs. The strategies that I often employed include: graphic organizers (Venn diagrams, tables, flow charts, and concept maps), Cornell Note Taking Technique, and the Before, During and After (BDA) reading strategies. For examples, when students are required to take notes, they are required to use the Cornell note technique. For this strategy, students are required to create a T—chart. In the left column they would identify the key concepts or ideas from the text which they use to formulate questions and then find the information in the text that will help them to answer the questions in the right column. For the BDA strategies, students are required to write all what they know about the topic or concept before they actually read the text. Once they are finished, they are allowed to read the text and where necessary address any misconceptions that they initially had before reading. After reading they can formulate or ask questions for further clarification. Graphic organizers are used to organize key information and concepts based on similarities and differences. The Venn diagram is often used because it lends itself to science concepts that required comparing and contrasting.

12. What strategies do you use to manage your inclusive classroom? (Probe/explanation: What do you do to maintain a classroom atmosphere that is conducive to learning? (respectful, orderly, positive, etc.)).

Keeping students on task at all time help to maintain a classroom atmosphere that is conducive for learning. At the start of each class period students are required to complete a warm-up activity. This activity may include but not limited to answering a few questions, reading a passage and

providing feedback, or completing a math problem. This is generally used to set the tone for the topic or concept to be cover during the period. By completing the warm-up activity, students would already have some knowledge of what is expected of them and so they can at least make a meaningful contribution to the lesson during discussion. Also, the objectives for the lesson as well as any assignments for the period are outlined on the board. These serves as a guide so students will know what they are require to do. For the most, part this keeps them focus throughout the period. In addition, students who finished ahead of time are given enrichment activity. This may include worksheet, reading/questions from the text or handout, or problems to solve. In this way they are being kept busy throughout the period.

Appendix F: Round 2 Sample Coding

7. What type of skills or training do you think would be necessary to enhance your work with special needs students? What skills/training do you currently have that serves you well? (probe)

teacher support

I need ongoing support from parents and special need teachers. Taking

welcomed more training

additional and advance special education courses or having ongoing professional development/workshops would enhance and refine my pedagogical skills. One of the courses that I have taken which help in dealing with special need students is Differentiated Instructions. This course provided some useful tips and strategies on how to plan and execute lessons that are developmentally appropriate for students whose reading and comprehension skills are at different grade levels.

11. Do you use the same strategies to teach students with and without special needs? (Probe: Tell me about these strategies and how they are the same or different)

The difference between special need students and those without is that

sp. ed. students provide less detail

more detail is required for students without special needs. For example, I may require regular students make all the comparison between osmosis and diffusion; while the special need students are required to identify 2 or 3 comparisons.

more detail (vs.) less detail

regular ed. / special ed.

Appendix G: Consent Form

High School Teachers' Perspectives on Effective Approaches Teaching Biology to Students with Special Needs

Walden University

You are invited to take part in a research study of high school teachers' perspectives and methods on how students with special needs learn biology. You were chosen for the study because of your past and current work as an educator who instructs high school biology students with and without special needs. Please read this form and ask any questions you have before agreeing to be part of the study.

This study is being conducted by a researcher named Agnieszka Kos, who is a doctoral student at Walden University.

Background Information:
The purpose of this study is to understand high school teachers' perspectives, practices and challenges in relation to special needs students in the classroom. These perspectives will be explored through a phone interview.

Procedures:
If you agree to be in this study, you will be asked to:

- Participate in a phone interview. This interview should take 30-45 minutes of your time.
- Participate in a follow-up phone interview if additional information is needed. This should take 15-30 minutes of your time. The phone interviews will be recorded and the relevant responses will be typed by the researcher and emailed back to you (participant) to check whether you agree with the responses. After you proofread your responses, the recording will be erased.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one at the institution you work at will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind later. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:
There are no risks associated with participating in this pilot study and there are no short or long-term benefits to participating in this study. The results of this study will help biology and other science teachers improve their teaching skills and thus benefit their special needs students who are included in a regular biology classroom.

Compensation:
There will be compensation provided in the form of a $10.00 gift certificate for your participation in this study.

Confidentiality:
Any information you provide will be kept private. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study. Research records will be kept in a fireproof safe; only the researcher will have access to the records.

Contacts and Questions:
The researcher's name is Agnieszka (Agnes) Kos. The researcher's faculty advisor is Dr. Laura Lynn. You may ask any questions you have now. Or if you have questions later, you may contact the researcher via (312) 330-2500 and agabogdan7@msn.com or the advisor at (410) 662-2797 and Laura.Lynn@email.waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Director of the Research Center at Walden University. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is 04-23-09-0234722 and it expires on May 26, 2010.

The researcher will give you a copy of this form to keep.

Statement of Consent:

☐ I have read the above information. I have received answers to any questions I have at this time. I am 18 years of age or older, and I consent to participate in the study.

Printed Name of Participant _____

Participant's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature agabogdan7@msn.com _____

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Appendix H: Permission Letters

[redacted]

Office of Research, Evaluation, and Accountability
[redacted]
Telephone: [redacted]
Fax: [redacted]

May 22, 2009

Agnieszka Kos
Walden University
4903 S. Lorel Ave.
Chicago, IL 60638

Dear Mrs. Kos:

Thank you for your interest in conducting research in [redacted]. The Research Review Board of the Office of Research, Evaluation, and Accountability has reviewed your proposal for research entitled High School Teachers Perspectives on Effective Approaches for Teaching Biology to Students with Special Needs and has approved your request to conduct research. Although your study has been approved, school principals have final authority over activities that are allowed to take place in the school. If data collection continues beyond a year from this approval, please complete the Modification & Continuing Review Process Checklist.

Upon completion of the research study, a copy of the final report or summary of the results must be provided to the Research Review Board. The Board reserves the right to use the information in the research report or summary for planning, solicitation of grants and staff development.

Please note that your study has been assigned Project ID #363. If you have any questions, please contact [redacted] on my staff at [redacted] If you need additional clarification after contacting [redacted] feel free to contact me at [redacted]

Sincerely,

[redacted]

Director of Program Evaluation and Applied Research
Chair, Research Review Board
Office of Research, Evaluation, and Accountability

[redacted]

[redacted]
Chief Executive Officer
[redacted]

Office of High Schools and High School Programs ·
[redacted]
Telephone [redacted] FAX [redacted]

[redacted]

[redacted]

March 12, 2009

Agnieszka Kos
4903 S. Lorel Avenue
Chicago, IL 60638

Dear Ms. Kos:

I am contacting you to offer my support and the support of my office, the Office of High Schools and High School Programs to conduct research in our high schools for your doctoral dissertation from Walden University.

We do, however, ask that you do the following:

1) Please contact [redacted] at [redacted]. He is the manager of Science education for the [redacted] and he would be an invaluable resource in providing assistance in contacting high school science teachers.
2) Please modify your data collection strategy of contacting teachers via home phone.

Good luck to you as you conduct your research. If you have additional questions, please contact [redacted]

Sincerely,

[redacted]

[redacted]

[redacted]

Educate. Inspire. Transform

[redacted]
Office of Specialized Services - [redacted]
Telephone: [redacted]

[redacted]
Chief Specialized Services Officer

OFFICE OF SPECIALIZED SERVICES

March 10, 2009

Research Review Board
Office of Research, Evaluation and Accountability
[redacted]

Attention Research Review Board:

I am submitting this letter on behalf of Agnieszka Kos, a doctoral student at Walden University. We are pleased to support the proposed research study that involves high school teachers' perspectives on effective approaches for teaching biology to students with special needs.

In this study 10-15 high school biology teachers will participate in a 45 minute phone interview and possible follow up interview from their home setting. The participation is strictly voluntary and there will be no interference with school instruction and operations.

The outcomes of this research study may improve science education by providing valuable information for possible professional development that addresses the methods used by the teachers. Thus, this study may benefit high school biology teachers and other science teachers, as well as their students.

This is an exciting research study that may help improve science instruction. As such, we grant our support.

Sincerely,

[redacted]
Director of Instruction

Curriculum Vitae

Agnieszka Kos
agabogdan7@msn.com

Education:

Walden University, Minneapolis, MN
Ph. D. Candidate, Science Curriculum, Instruction, and Assessment (degree expected, 2010)
Master of Arts in Education, Saint Xavier University, 2000
Bachelor of Science (Biology major and Chemistry minor), University of Illinois at Chicago, 1997

Certificate:

Type 9, Completed State Approved Program in Biology
Illinois State Board Certified Teacher (ISBCT)

Endorsements:

High School: biology, botany, chemistry, general science, physics, & zoology
Middle Grades: biological science, general science, physical & science
Language Endorsed – Kindergarten to Grade 12: Polish

Experience:

Kelly High School, Chicago, IL
1999-Present Science Teacher
Subjects: Biology and Honors Biology
Earth Space/Science

Mentor for First Year Teachers, 2003-2004, 2006-2007

Cooperating Teacher Assignment, 2006

Science Fair Coordinator, 1999-2000

Professional Development:

Helping Children with Auditory Processing Disorders, 2007

Mentor Workshop, 2007

Participated in Extensive Summer Science Teaching Methods Workshop – Creating a Critical Mass for Chain Reaction of Change, Columbia College Science Institute, 2005

Educating Everybody's Children, Summer 2003

Current Research in Biology, University of Chicago, 2001-2002

	Science Teachers Exchange Program, University of Chicago, 2001-2002
Professional Presentations:	Proposal Poster Presentation, Methods Employed by Biology Teachers to Teach Students with Special Needs, Walden University, 2009
Awards Committee:	Assessed Graduate Poster Presentations in Field of Science, University of Illinois at Chicago, 2009
	Assessed High School Science Poster Presentations, Chicago Public Schools, 2002
Work in Progress:	Developed a lesson that focused on how students use a compound microscope and a digital microscope to learn. These tools were compared to determine which of them serve better to enhance students' learning.
	Collaborate and provide professional development to my colleagues about the effectiveness of digital microscopy versus the compound microscope.
	Developed a psychosocial model to explore how adolescents develop socially and psychologically.
	Explored students' understanding of viruses by employing a systems thinking approach.
	Developed a manual for science methods course and high school science teachers that demonstrates how to develop an inquiry-based instruction.
	Collaboratively analyze student data to determine progress, address student academic deficiencies, and arrive with solutions.
Professional Affiliations:	American Federation of Teachers, 1999-Present National American Biology Teacher, 1999-Present Golden Key National Honor Society, 1997-Present UIC Honors College, 1996-1997
Recognition:	Who's Who Among American Teachers and Educators