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The Effect of Special Education Student Participation and Engagement in Mathematics on Student Achievement

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Doctor of Education

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Abstract

Engagement in mathematics lessons has a positive impact on student numeracy achievement. Yet special education students have experienced a significant drop in mathematics achievement from one year to the next, and this gap continues to grow. This mixed methods study examined the extent to which equal opportunities, similar to those offered to regular education students, are provided to special education students. It contributes to the body of knowledge regarding level of engagement of regular and special education students, the impact of their increased participation and engagement on numeracy achievement, and the ways to increase their level of engagement. Grounded in Kamii's theory of constructivism, Vygotsky's notion of the zone of proximal development, and Schon's reform of teaching and learning, the research questions addressed the level of participation of special and regular education students, the impact of increased engagement, and ways in which teachers can increase the level of engagement during lessons. Utilizing a concurrent nested strategy, the study utilized a sample of 375 students. The qualitative portion focused on text analysis of interview transcripts, and the quantitative portion focused on teacher/student interactions for each group. Results indicated that special education students are not as engaged in numeracy lessons, which may hinder their numeracy achievement. Findings revealed that special education students are being denied more than one-third of their deserved engagement time. Implementing more effective teaching strategies is recommended as a means to increase levels of engagement. Educators in every role may benefit from the results of this study. Social justice and positive social change is an urgent need for them in terms of quality of service.

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Section 1: Introduction to the Study

Classrooms, which are the basic building units of every school, currently contain students with different learning profiles and abilities. Although each of them has their own strengths and weaknesses, they all need to be allowed to reach their own potential, including the special education students. Instruction must match the students' levels in terms of knowledge, skills, and performance (Martel, 2006). No one child should suffer for academic instruction and teacher attention to the benefit of other students. The gap is evident in profiles of special education students in mathematics who are currently functioning a few years below grade level in mathematics. By the time the students reach the late elementary grades, there is significant underachievement in numeracy evident in academic assessment scores and psychological assessment scores administered by school special education teachers and board psychometrists respectively.

One possible contributor to this problem is the approach used to teach mathematics. Mathematics, as taught in the traditional fashion, has often failed to be as relevant and exciting as when mathematics is applied to real-world situations (Schoen and Ziebarth, 1997). A change in the way mathematics is taught was proposed by the National Council of Teachers of Mathematics (NCTM, 1989). The NCTM reform required that students learn to communicate mathematically, use mathematics to solve real-world problems, engage in higher order reasoning, develop an appreciation for mathematics, and believe in their own mathematics ability. Good pedagogy and teaching implies students being exposed to problem solving in mathematics that is directly related to real world situations. This will allow them to be better prepared to function in society.

This study was conducted in response to assessment results that show widespread mathematics underachievement. Due to concerns regarding students' struggles in mathematics in many communities of practice, researchers have suggested that using proper teaching techniques is equally effective for regular and special education students. The present study contributes to the body of knowledge regarding factors such as level of participation of special education students and regular students during mathematics lessons, the impact of increased student participation and engagement in mathematics lessons on special education students, and ways that teachers can increase the level of engagement of special education students during lessons in this subject area. In addition, the study provides some initial data and information that may inform educational policy, practice, and reform in this area. Educators in the various roles must ensure that numeracy programs are in place and led by fully qualified teachers and other professionals.

This study addressed the impact of special education student participation and engagement in mathematics and how teachers can increase the level of engagement of special education students during mathematics lessons. Special education students need to interact more during mathematics lessons in order to learn mathematical concepts (Kamii, 1987). These students do not experience the opportunity to articulate or demonstrate their arguments or thinking processes in answering questions or solving problems—in other words, how they construct logico-mathematical knowledge. Constructivism holds that the learner constructs knowledge through interaction with the learning environment—the constructivist learning experience (Kamii, 1987). Students construct knowledge one concept at a time, and proceeding from the known to the unknown. Therefore, by allowing students to articulate their reasoning, and trying to follow their argument, teachers may be able to dissect students' thinking processes. With teacher assistance, some students may be able to generate partial answers to the questions asked by the teacher. Articulation of the process used in answering questions and solving problems by the student, along with appropriate probing techniques by the teacher, may reveal the limits of the students' understanding of the mathematics concepts presented.

Performing sound formative evaluation during the development part of the lesson is of utmost importance. This practice keeps students actively engaged for the duration of mathematics lessons and avoids the problem of students rarely or never being called upon for input and participation, thereby minimizing passivity, distraction, and inattention during instruction time. Undivided attention, paid to instruction on students' behalf, depends on teachers ensuring their active engagement. The proposed analysis examines whether the label special education student in mathematics in fact denies the student equality of participation and active engagement, and thus prevents learning and improved student achievement. By providing continuous direction and assistance, teachers are the main instruments in mediation during mathematics lessons (Walqui, 2006). Martel (2006) found that instruction is effective only when matched to knowledge, skills, and performance levels. Evaluation of this nature groups students by ability level and programs appropriately to allow all students to learn the numeracy concepts presented.

The introduction of district school board policies and guidelines, such as the Appropriate Age Placement (AAP) Policy and mainstreaming, may have created deficiencies and gaps in the teaching and learning process. Inclusion of special education students in mathematics in the regular classroom may have contributed to less effective teaching practices due to the ability profile composition of the class and time restraints, eventually leading to gaps in numeracy achievement. In every mathematics course, the classroom teacher is expected to teach students with varied academic abilities, learning profiles, and learning styles. According to results obtained from the current study, this expectation is indeed an issue and one that merits attention and investigation. The purpose of this research was to determine whether the learning gap for this student populace is increasing due to their academic abilities alone, or if marginalization in the classroom and instructional strategies and methodologies also contribute. The goal of this study was to improve teaching methodologies and increase achievement in mathematics for this marginalized and deserving group of students.

Marginalized groups are defined as those groups that are most underserved and underrepresented and that face various forms of oppression in schools (Marshall & Oliva, 2006). Positive social change results in improvement of such human and social conditions (Laureate Education, 2006). Diaz (2008) stated that mathematics literacy is imperative to success in society. Early experience is important for acquiring mathematics literacy. If educational institutions are to provide a positive future for all students in the system to the extent that they are able, then social justice is necessary for all of them, including special education students. Innovative and fair teaching strategies may provide these students different approaches and opportunities, possibly leading to enhanced learning and improvement in student achievement.

Statement of the Problem

There is a problem in education in that special education students are failing to achieve in mathematics. I attempted to examine the possible reasons for this failure. One major problem may be that although most classroom teachers try to be fair and equal in calling upon these students as often as regular students, in fact special education students are not being engaged enough in the development part of mathematics lessons. Teachers tend to avoid repeated incidences of getting off track in lessons for better flow of the lessons and to cover the curriculum for the respective reporting period. However, allowing these students to articulate the process used in answering questions or solving problems in mathematics and teachers trying to understand their argument is imperative for a sound formative evaluation process. The benefit of this process is twofold: to the students who are striving to learn, and to the teacher who is trying to evaluate the students' learning.

Such teaching practices may be barriers that deprive special education students of opportunities to improve in achievement in numeracy. Research in this area has been conducted by Loeber (2008) and Lalley and Miller (2006). Results from their studies indicate that incentives and opportunities must be provided for students to answer questions and solve problems. Education for all must span all school systems and must be reflected at all levels of the political arena. A gap in the literature does not a problem make. It is the lack of understanding, not yet resolved in the literature, which is the problem. The research questions posed in this study will address this issue.

This gap is important to address since it may be a factor affecting special education student numeracy achievement. The problem of the drop in student achievement in mathematics may be due to the level of engagement of special education students during mathematics lessons. Studies were conducted by Loeber (2008), Levy (2008), and Anderson (2007). According to Loeber (2008), social changes in mathematics teaching may not only guide improvement in student achievement, but may also develop proficient mathematicians in the elementary setting. This applies to both regular and special education students alike.

Differentiated instruction hypothesizes that students differ in their learning profiles and that all students learn best when they are instructed through different modalities that appeal to varied interests (Levy, 2008). This type of instruction, for instance, allows teachers to be responsive rather than reactive to the unique and individual backgrounds of students (Anderson, 2007). Although important for grounding this study, these findings are not satisfactory in terms of answering the research questions it posed. A gap exists in the literature, and has led to misinformed teaching approaches. To address this problem in the classroom, the first step is to address this gap in the literature.

Special education students in the middle elementary grades are being denied the opportunity to participate and engage in learning mathematics, a situation which has created social injustice. This problem merits attention and further investigation. From this perspective, no one child should suffer in terms of academic instruction and teacher attention at the expense of other students. Through active participation, the students will reveal their thinking processes and understanding of the subject. I investigated the impact of increased student participation and engagement in mathematics lessons on special education students and how teachers can increase the level of engagement of special education students during these lessons.

My study contributed to the body of knowledge needed to address and promote positive social change by providing recommendations that school systems may consider for increasing student achievement in mathematics for this student populace. Through active participation, the students will reveal their thinking processes and understanding of the subject. From this perspective, no one child should suffer in terms of academic instruction and teacher attention at the expense of other students. Special education students in mathematics demonstrate minimal increases in student achievement in mathematics from one year to the next, and the gap keeps increasing (Ontario Ministry of Education, 2004). The gap becomes quite evident and clear in their academic assessments when these students reach the intermediate grades. These students are unprepared mathematically to function in present society. Some factors contributing to this problem may have been the instruction and integration of special education students in the classroom via the introduction of new policies and guidelines by the ministries and school boards.

Nature of the Study and Research Questions

This study was a mixed methods inquiry. The qualitative portion was nested in the quantitative portion. There was one data collection phase; the quantitative and the qualitative data were collected simultaneously. Collection of both quantitative and qualitative data was necessary to answer the research questions. Amalgamation of the data was necessary during the data analysis phase.

In the first part, the qualitative study, the participants involved seven classroom teachers. Through purposeful sampling, the volunteer teachers were chosen in a small group at one campus. The rationale for this strategy was the importance of both the qualitative and the quantitative data. Integration occurred at the data analysis phase. Results of the study are presented in section 4.

Qualitative research is not simply learning about the topic, but also learning what is important to those being studied (Rubin & Rubin, 2005). Questionnaires and interviews were used for the qualitative study. The first step, the completion of a questionnaire with the campus principal (Appendix A), served to collect data on the demographics of the school. For the second step, the interview process, involved a second specific group with its own set of research questions—seven campus classroom teachers (four female teachers and three male teachers) (Appendix B). All required questionnaires and interview questions were drafted ahead of time, ensuring that teachers received the same set of questions. Because it had less priority, the qualitative method was nested within the quantitative method (Creswell, 2003).

For the second part, the quantitative study, I used a structured observation protocol and observed classrooms to gather observed interactions between teachers and students, coding the observations according to student group membership. An ongoing observation log was kept to note the classroom interactions between the classroom teacher and the regular students and the classroom teacher and the special education students. In this data collection phase, I focused on the number of times each student group interacted directly with the classroom teacher in eliciting responses to teacher-directed questions (Appendix C). The independent variable for this study was the student group with two levels, namely the special education students and the regular students. The dependent variables were the frequencies and percentages of classroom interactions during mathematics lessons.

This mixed method study analyzed the impact of special education student participation and engagement in mathematics. It extended knowledge of whether their slow growth in achievement in numeracy is due to their cognitive abilities, learning styles, and profiles or whether participation and engagement in mathematics lessons are added factors. The data collected were used to examine whether the learning gap for these students is increasing due to passive student behavior and marginalization in the classroom due to teaching methodologies. The results may serve as a trigger leading to re-visitation of special education policy and instructional techniques in-services for teachers. Research of this nature reminds educators of the urgency to become more savvy consumers of research (Honig, 2006).

For the quantitative portion of the study, the data analysis involved descriptive statistics, including the number of teacher/student interactions for each group, and percentages. In regard to the qualitative portion of the study, data analysis involved text analysis of transcribed interview data, which were coded for themes. There were both internal and external validity threats in this study. Internal validity threats were students refusing to respond to teacher-directed questions and participants being absent during the study or part of the study. External validity threats may have arisen if incorrect inferences were drawn from the sample data to other settings such as the impact of special education student participation and engagement in mathematics lessons in a withdrawal support model in small group settings.

The study addressed the following research questions:

Q1: What is the level of participation of special education students and regular education students during mathematics lessons?

Q2: What is the impact of increased student participation and engagement in mathematics lessons on special education students?

Q3: How can teachers increase the level of engagement of special education students during mathematics lessons?

Based on current levels of knowledge and experience, all students can learn if they are provided with sufficient and adequate opportunities and the right learning environment. Whole-class instruction is teacher-directed and is used to introduce new materials and strategies to the entire class (Valentino, 2007). Most teachers try to be fair in regard to level of participation of special education students and regular students in mathematics lessons. However, to make the lesson flow better, and to avoid repeated incidences of getting off track, evidence suggests a slight teacher preference to call more upon the regular students, where there is no teacher assisted performance. According to the notion of the zone of proximal development (Vygotsky, 1978), in the case of special education students where there is still teacher assisted performance, the student's response indicates that the student has not yet proceeded to a level of independent performance in this area.

New factors affecting classroom management and instructional techniques have surfaced on the educational stage, namely accountability and curriculum intensity. Of these two, accountability seems to be the largest influence on present education systems. Teachers will tend to call upon this group more to “get through” the lessons, especially when they are pressed for time to teach and cover the curriculum for the respective reporting period. The main concern is in regard to the mathematics curriculum, due to the various strands to report on each term. This study arose from this problem.

Purpose of the Study

The current study explored current practices in the study setting. Research Question 1 was aimed at determining the level of participation of special education students and regular education students during mathematics lessons. The purpose of this question was to examine the frequencies and percentages of classroom interactions during mathematics lessons in terms of eliciting responses to teacher-directed questions. Research Question 2 aimed to determine the impact of increased student participation and engagement in mathematics lessons on special education students. In interview narratives, the question was investigated through questions asking for examples of how high participation of special education students in mathematics impacted the students. The aim of Research Question 3 was to determine how teachers can increase the level of engagement of special education students during mathematics lessons. In interview narratives, the question was addressed through questions asking for examples of successful practices of teachers to increase the level of special education student engagement in mathematics.

This student populace needs to improve in student achievement in the area of numeracy. Instructional techniques may need to be revisited to bring about positive social change and social justice in regard to this issue. In best practice, mathematics instruction currently aims at allowing students to experience mathematics in ways it is used in the real world (Ebby, Ottinger, & Silver, 2007). The goal for special education students is no different: Instruction is meant to prepare special education students so that they can function in the workforce. Curriculum must be delivered and instruction must be crafted to allow all youngsters to learn to their maximum potential, even if in small increments at a time.

Theoretical and Conceptual Framework

The theoretical foundation for this study was constructivist learning. Constructivism is based on the process by which children create and develop their ideas or knowledge (Lunenberg & Ornstein, 2004). How students construct knowledge is not known. During lessons, students should be asked routinely to discuss and clarify their own thinking about mathematical ideas, and to make convincing arguments. Teacher awareness of these issues and learning in regard to pedagogy is empirical (Caldwell, 1995). Ball et al. (2005) suggested that teacher learning must include additional mathematics content classes, extended mathematics institutes, lesson study, and collaboration with peers. Ultimately, the aims are to improve learning and increase achievement in numeracy for this student populace.

From a historical perspective, effective leadership behavior is centered in learning, student achievement, and, ultimately, social change. Schools have become places where all students are expected to learn and where high standards set the vision of educational success for all students (Bennis, 2006). Through active participation, and thus by articulating their thinking process, the teachers can determine the limit of their understanding of the subject matter (Kamii, 1987). From this perspective, no one child should suffer in terms of academic instruction and teacher attention at the expense of other students. Ongoing teacher/student talk during the development of a lesson will allow aspects such as these to surface. Mathematics is taught for understanding (O'Donnell, 2006; Van de Walle & Lovin, 2006). The concept of social justice focuses on marginalized groups, such as special education students in mathematics.

If education is a fundamental right, then everyone is entitled to it (Alexander & Alexander, 2005). All children need to be actively engaged in lessons if learning is to occur. The content, process, product, and learning environment must be shaped to allow enhanced success for all students. Murphy (2005) stated that both principal and teacher leadership have a significant influence on important features in the school. One of these features is instructional techniques. Teachers must provide these students with different approaches and opportunities to enhance their learning. They must be responsive to a wide range of readiness levels, varying interests, and varying learning profiles (Tomlinson, 2005).

During mathematics lessons, teachers must engage students through active participation in the development part of the lesson. Teacher-student dialogue is an integral part of the teaching / learning process. Students need to articulate the process. Allowing them to articulate their reasoning gives teachers the opportunity to listen to and follow their argument and reasoning. Kamii and DeVries (1977) argued for the importance of articulating the process because it is of utmost importance in both formative and summative evaluations. It reveals the thinking process, allowing the teacher to determine the limits of the students' understanding of concepts.

Constructivism is based on the processes by which children create and develop their ideas or knowledge (Lunenberg & Ornstein, 2004). This is where the gap exists. The opportunity is usually given to regular students in the classroom. However, many students are alternative learners. They are referred to as "special education students." Ninety percent of the day, special education students are integrated in the regular classroom setting for lessons for the various subject areas, including mathematics.

According to the notion of the ZPD (Vygotsky, 1978), in the case in which there is still teacher-assisted performance, the student's response indicates that he/she has not yet grasped the mathematical concept presented. Scaffolding is defined as the precise help that enables a learner to achieve this specific goal that would not be otherwise possible (Sharpe, 2006). Vygotsky's ZPD is the distance between a child's actual development level and the level of potential development as determined through problem-solving under guidance and collaboration (Cole, 2006). Research has shown that through scaffolding, students are able to reach the ZPD (Kamii, 1987). This theory is the main reason why students need to be actively engaged in lessons and called upon to elicit responses and articulate their reasoning.

All students need to be asked routinely to clarify their own thinking about mathematical ideas (Caldwell, 1995). Special education students need the opportunity to articulate responses as well. Sibley (2007) continued to reinforce conversation and reflective thought as instruction time closed. With teacher assistance, some students may be able to come up with part of the answer. This type of instruction allows teachers to be responsive as opposed to reactive to the unique and individual backgrounds of students (Anderson, 2007). Learning is promoted when students work together (Freirweiss, 2006). Schon (1983) stated that if it is true that professional practice has at least as much to do with finding the problem as with solving the problem found, then it is also true that problem setting is a recognized professional activity. The study will provide advancement to the field of education not just by providing a solution for learning but by clarifying the root of the problem.

Definition of Terms

In this study, as in any study, it was important to define terms. According to Creswell (2003), terms that the reader will not know need to be defined, as well as terms as they first appear in the study. Terms describing both independent and dependent variables need to be defined. These are “alternative learners,” “development of lessons,” “engagement,” “frequency,” “marginalized groups,” “special education students,” and “student groups.” The following are the definitions of the terms for the purposes of this study.

Alternative learners: Alternative learners are students or learners in systems whose learning styles and profiles differ from the majority of the students in the class (Ontario Ministry of Education, 2004).

Development of lessons: The part of a lesson in which new concepts and skills needed to be learned that is introduced for purposes of allowing growth of knowledge (Hawley & Rollie, 2002)

Engagement: To pay attention to and to take active part in a lesson (Ontario Ministry of Education, 2004).

Frequency: The rate of occurrence of classroom participation (Ontario Ministry of Education, 2004).

Marginalized groups: Those groups that are most underserved and underrepresented and that face oppression in schools (Marshall & Oliva, 2006).

Special education students: Students in an education system whose learning abilities and profiles differ from the majority of other students, therefore requiring accommodations to the learning environment and modifications to their academic programs (Marshall & Oliva, 2006).

Student groups: There is a student group with two levels, namely the special education students with a ministry defined exceptionality and the regular education (Ontario Ministry of Education, 2004).

Scope and Delimitations

As in any study, it is important to define the scope and establish the delimitations. Academic assessments and report cards indicate that the progress made in mathematics by special education students from one year to the next is minimal, and the achievement gap keeps growing. The study was conducted in a high school. It involved students in mathematics in Grades 9 to 12 inclusive. Because there was a fairly even distribution of special education students in all grades at this site, and a number of classes and courses in each grade level, solid data collection for purposes of analysis and reporting was ensured.

Creswell (2003) stated that delimitations are used to narrow the scope of a study. In this study, I confined myself to observing students from diverse cultural backgrounds and with varied academic profiles and abilities in the secondary school grades in southern Ontario, Canada. The lessons observed or audio-recorded were exclusively mathematics lessons. Other delimitations were that some of the students/subjects were receiving special education services or support in mathematics. Research was conducted by an experienced special education teacher.

An even representation of teachers and students from every mathematics grade level was selected. All participants were selected from one site. Subjects in this study involved students in mathematics from Grade 9 to 12 inclusive along with seven campus teachers (four females and three males). For purposes of data collection, it was assumed that each grade level contained approximately the same number of special education students. These figures are recorded in section 4.

There were three delimitations to this study. First, the study was delimited to one high school in one school district. Second, the subjects were students receiving instruction in the subject area of mathematics. These included regular and special education students in the various mathematics level courses. Third, this sample was not representative of the student populations of other district school boards.

Assumptions and Limitations of the Study

The first assumption was that the students would all participate in the mathematics lessons and would all be present during the data collection periods for the duration of the study. The second was that the principal would consent to the study and the teachers would agree to participate in it. Finally, the third assumption was that the students would be cooperative during the delivery of mathematics lessons. These facts were assumed to be true but could not have actually been verified until the study was conducted (Laureate Education, 2005). In this study, the student subjects were limited to regular and special education students in Grades 9 to 12 inclusive who were receiving instruction in the subject area of mathematics in the regular classroom.

Significance of the Study

Inclusion has caused school systems to change and create an educational environment that allows students to participate in every aspect of school life (Terpstra & Tamura, 2008). One main aspect is inclusion of special education students in mathematics lessons. Jacobs (2008) found that teachers felt that inclusion would benefit students with and without disabilities, as well as teachers. Although inclusion is practiced by most school boards, an injustice still prevails in many education systems toward special education students who are striving to learn and improve in student achievement. Social justice is necessary for them. Many students in both national and international education systems are alternative learners or special education students, and deserve opportunities to develop academically to their fullest potential.

A study to determine the impact of active engagement and participation in mathematics lessons and how teachers can affect the level of participation and engagement of special education students in mathematics lessons was important for several reasons. First, to achieve higher levels of performance, school districts must develop an effective plan for teacher in-services and workshops on effective mathematics instructional strategies and techniques. Second, through the study, I strove to increase student achievement in mathematics for this marginalized group. School systems and administrators would be provided with additional information to utilize when considering instructional techniques, planning in-services, and conducting de-briefing sessions about teacher performance appraisals. Finally, if schools are to become promoters of social change by going beyond our current practices, then best practices need to permeate every lesson, regardless of the mathematics strand being taught.

The results of this study contributed to the body of knowledge needed to promote positive social change by providing guidance regarding steps that school systems can take to enhance student achievement. Creswell (2003) stated that a study adds to scholarly research and literature in the field and helps to improve practice. This study extended knowledge of whether special education students' slow rate of achievement in mathematics is due to their learning abilities and profiles alone or if instructional techniques in terms of participation and engagement are added factors. In terms of professional application and practice, the study provided substantial data for classroom teachers about questioning and instructional techniques, along with classroom management techniques during the delivery of mathematics lessons. Learning through problem-solving is a vehicle for understanding mathematics (Ball et al., 2005). Providing school principals/administrators with advice for the observation sessions during teacher performance appraisals was another goal of this research.

Substantial data were collected and presented that may be conducive to special education policies and procedures implemented by school boards. This process was guided by the belief that policy and practice inform each other. Results from this study will be of particular interest to leaders such as principals who aspire to positive social change and to lead their organizations in the direction of excellence. In addition, findings will provide other researchers with information on deficiencies in instructional techniques in the classroom. The ultimate goal is positive social change for special education children who strive for improvement in their academic achievement and for the brightest possible future.

The study revealed information that may influence the larger arena of education. It met the identified needs of many school communities and those of special education students, along with making a contribution to the field of education. Of importance also is the generation of knowledge, professional application, and social justice. Educational practice in organizations and the larger education community may be impacted by these findings. Results from this study may also inform policy and practice of reforms necessary to promote social change among communities of practice. Given that reform to promote development of individuals and learning communities often occurs due to actions taken by administrators and other school leaders in response to a particular problem, leaders must possess strong leadership skills that represent a shift from being an administrator leader to being a leader in the education profession. As a result of this, educational leaders are reminded of the urgency of becoming more savvy consumers of research (Honig, 2006). Creating a community of practice is the first step toward achieving this goal.

Many studies supporting the importance of this one have been conducted. According to Lunenberg and Ornstein (2004), constructivism is based on the process by which children create and develop their ideas or knowledge. In addition, much research has supported an increase in instructional time in mathematics (Jennings & Likis, 2005; Lalley & Miller, 2006; Parrett, 2005). Schools are agents of social change

(Laureate Education, 2007). Public schools will forever be challenged by their obligations to serve a growing, changing, and learning public (Donaldson, 2006).

Summary

Achievement in mathematics for special education students is dropping, and the achievement gap is getting wider. A leader for social change needs to become familiar with the school, understand the organization, develop a shared vision and mission among the staff, and lead the organization in the direction of excellence. Thinking big, yet introducing change in small steps is crucial. Reflection-in-action is an important part of growth for educators. Part of the process of becoming an authentic leader is constant reflection on one's own attitudes, beliefs, and practice. Of importance also is determining how the findings will reform teaching and learning (Schon, 1983), therefore advancing the betterment of society at large.

The goals of this study were to improve educational practice in the elementary panel, bring about positive social change in school communities, improve achievement for special education students, and make a contribution to the field of education. There is an urgent need for these students to improve in mathematics for their effective functioning in society. This study provided the inspiration and foundation for educational reform. Increased academic instructional time promotes achievement (Bukas & Patterson, 2006; Fratt, 2006; Parrett, 2005; Reeves, 2006; Royal, 2007). Bringing about positive social change for special education students requires involvement of all players in the profession–teachers, administrators, and members of government at both the provincial/state and federal levels.

Transition Statement

Section 1 introduced the general scope of the study and discussed the need for research on this topic. A thorough literature review will be presented in section 2. Following this, in section 3, I will discuss the methodology used. In section 4, I will present the qualitative and quantitative data. Equally important is assessment of practical implications of the findings in light of prior theories and research findings (D'Andrade, 2007). Section 5 will entail a summary of the study, conclusions, recommendations, and commentary.

Upon the completion of this study it is important to reflect on three main aspects. First is improvement of student achievement when special education students are called upon more frequently, therefore increasing their participation and engagement. Second is the application of the study to the larger arena, which implies suggestions for further study. Third is the way the findings could reform teaching and learning (Schon, 1983). The goals are to promote positive social change and social justice, improve student achievement in mathematics for these youngsters so they may better function in society, and advance the betterment of society at large.

Section 2: Literature Review

In this literature review, I provide background on whether special education students in secondary school mathematics courses are given equal learning opportunities to those offered to regular students during mathematics lessons. Special education students have a right to an education and to reach their maximum learning potential. Social justice and positive social change is necessary for this marginalized group of students to improve in mathematics, one of the major focuses of the curriculum. Alexander and Alexander (2005) stated that if education is a fundamental right, then everyone is entitled to it by virtue of being human. From that proclamation, children need to be actively engaged in lessons so they can acquire the numeracy skills necessary to function in society.

The study investigated whether the label *special education student* does in fact deny the student equal opportunity to participate, learn, and improve. New policies and guidelines in educational systems may create deficiencies and gaps. As a main objective, this study focused on the achievement gap in mathematics for special education students. It is grounded in the literature of researchers such as Kamii (1987), Marshall and Oliva (2006), Schon (1983), Vygotsky (1978), Creswell (1998), and Murphy (2005). Theories and results of other related studies are shared, and distinctions are made between past studies and this one (Creswell, 2003).

Diaz (2008) stated that mathematics literacy is imperative to success in society. Early experience is important for acquiring mathematics literacy. Diaz described the interactions between teachers and preschoolers. Of primary concern were the teachers' responsive interactions to children's expressions of an implicit mathematical utterance while engaged in block play. Student-teacher dialogue is key to allowing children to reveal their thinking. Students must be provided different approaches and repeated opportunities to enhance their learning. Content, process, product, and learning environment must be shaped to enhance success for all students.

All students have different learning profiles and abilities. Each is at a different stage along the spectrum. This spectrum also applies to special education students. Martel (2006) hypothesized that instruction is effective only when it is matched to knowledge, skills, and performance levels. No one child should suffer for academic instruction and teacher attention to the benefit of other students.

Special education students experience a significant drop in achievement in mathematics from one year to the next (Ontario Ministry of Education, 2004). This study investigated the impact of special education students' participation and engagement in mathematics in during lessons in mathematics. The special education students need to articulate their reasoning regularly to allow the teacher to try to follow their argument. Although most classroom teachers try to be fair and equal in calling upon special education students compared to regular students, evidence suggests that there is a slight teacher preference to call upon the regular students more often to ensure better flow of the lessons, lesson completion, and curriculum coverage and accountability. However, if education is a fundamental right, then everyone is entitled to it by virtue of being human (Alexander and Alexander, 2005), which includes every aspect of the teaching and learning process.

Basis for the Study

Achievement in mathematics for special education students is a significant problem that is worthy of study. The goal was to determine whether social change is necessary to improve such achievement. This problem permeates school districts enforcing the Age Appropriate Placement (AAP) Policy, in which the students are not retained. Special education students are integrated into the regular classroom with regularly scheduled support from special education teachers and educational assistants on a withdrawal or in-class support model. Inclusion has caused school systems to create educational environments that allow all students to participate in every aspect of school life (Terpstra & Tamura, 2008). Inclusive education does not separate out students with disabilities; consequently, instructional strategies must be modified to enable all students to access the content and demonstrate what they have learned (Cigman, 2007).

Student Achievement in Numeracy

Kamii (1987) stated that the only way to follow the students' reasoning is by allowing them to articulate their reasoning or logic and by the teachers trying to follow their arguments. According to Vygotsky's (1978) ZPD, in the case where there is still teacher-assisted performance, the student's response indicates that the student has not yet proceeded to a level of independent performance in this area. Scaffolding is defined as the precise help that enables a learner to achieve a specific goal that would not be possible without some kind of support (Sharpe, 2006). Vygotsky's ZPD is the distance between a child's actual development level and the level of potential development as determined through problem-solving under guidance or collaboration

(Cole, 2006). Through scaffolding, students can reach the ZPD (Kamii, 1987). Teachers are the main instruments utilized in mediation (Walqui, 2006), and special education students can improve in achievement provided they are given the right conditions.

Loeber (2008) revealed that teacher self-efficacy was a contributing factor to the significant difference found between implementation levels. Teacher self-efficacy can guide best teaching practices in the classroom. Social changes in mathematics teaching may not only guide improvement in student achievement, but may also develop proficient mathematicians in the school setting. Loeber's conclusion was that all students should have access to high quality, engaging mathematics instruction. In addition, a mixture of direct instruction, differentiated instruction, structured investigation, and open exploration can lead to effective learning among students. Differentiated instruction hypothesizes that students differ in their learning profiles and that all students learn best when they are instructed through different modalities that appeal to varied interests (Levy, 2008). This type of instruction allows teachers to be responsive as opposed to reactive to students' unique backgrounds (Anderson, 2007).

DiBrienza (2008) examined the development of adaptive expertise in understanding of subtraction among second grade students. While this research situates the goal of understanding subtraction within the frame of adaptive expertise, it also seeks to help educators identify points early in a trajectory that may help support the development of adaptive expertise. Several aspects were confirmed by this research such as difficulties in multi-digit subtraction, the importance for students to make sense of the mathematical work they are engaged in, and the adaptive expertise in subtraction that was lacking in the intervention group. Allowing students to articulate the steps used in answering questions, thereby revealing their thinking process, is essential in determining whether they are making sense of the mathematical work. All teachers must exercise this best practice.

Special education students have a right to be actively engaged in lessons, learn, and improve. One way to evaluate their success is to assess whether students are following mathematics lessons through formative evaluation, both in oral and written forms. Lindsey, Roberts and CampbellJones 2005) stated that teachers have not been educating all children, and indeed, may not have the will to do so. Many scholars in the field share this social justice concern. Lalley and Miller (2006) found that pre-teaching and re-teaching resulted in substantial improvement in achievement. It provided information about the effect of the study on achievement for special education students in mathematics, the student population that will benefit from the findings of this study. Research of this kind reminds educational leaders of the urgency of becoming more savvy consumers of research (Honig, 2006).

Evidence suggests that understanding how these educational theories and practices inform each other is crucial in informing decisions. There is a need for leaders in the field of education to be abreast and in tune with current research in education (Honig, 2006), since it ultimately affects their organization and community of practice. Strong, positive decisions promote student achievement, social justice, and positive social change. There are two important aspects to consider. Firstly, how the findings will reform teaching and learning (Schon, 1983), therefore advancing the betterment of the future society schools are presently educating. Secondly, how the findings will help steer and lead the organization toward excellence (Laureate Education, 2006). Given the fact that effective teaching and learning complement each other, ultimately the benefit is intended for all members in the organization, regular and special education students alike.

Student Underachievement in Mathematics

Constructivism is based on the processes by which children create and develop their own ideas of knowledge (Lunenberg & Ornstein, 2004). According to Walker (2002), the central metaphor for constructivist leadership is of weaving a cloth from threads of different textures, colors, and lengths. Murphy (2005) stated that teacher leadership has a significant influence on important features of the school. Through formative evaluation, teachers can monitor the lesson in progress, decide if mini-lessons are required for special education students, determine the starting point for the next lesson, and decide how to group students based on their levels and understanding. Keeping special education students actively engaged in lessons allows for this type of evaluation. This type of active interest is where the gap exists.

Every student has a different learning style or profile, and each understand concepts at different rates. However, schools have become places where all students are expected to learn and high learning standards set the vision of educational success (Bennis, 2006). Through active participation, evidence suggests that students will reveal their thinking process and understanding of the subject, which allows teachers to follow their arguments (Kamii, 1987). Teacher-talk and student-talk during the development of a lesson will allow these aspects to surface. It is also an opportune moment to determine the limits of student understanding of the concepts and skills presented.

Although age appropriate placement benefits special education students socially, academic benefit must be present as well. Solving a problem in one place has created gaps in others. Being actively engaged in lessons increases the chances for this to materialize. Special education students represent a marginalized group, one that is most underserved and that faces various forms of oppression in schools (Marshall & Oliva, 2006). Sergiovanni (2005) stated that improvement of student achievement results by focusing on teaching and learning with teachers playing key roles, such as monitoring classroom discourse and performing formative evaluations during lessons. Investigation and analysis occurs best during student-teacher dialogue in large, as well as small, group settings. The teacher must be responsive to a wide range of readiness levels, varying interests, and varying learning profiles (Tomlinson, 2005).

The Achievement Gap

According to Kamii (1987), how students construct knowledge is not known. Teachers do not know what is going on in students' minds or how they construct knowledge. The only way to follow their reasoning is by allowing them to articulate it while teachers try to follow their arguments. Kamii and DeVries (1977) stated that it is important to articulate the process. Sibley (2007) continued to reinforce conversation and reflective thought as instructional time ended. Learning is promoted when students work together (Freirweiss, 2006).

Public schools were originally established to distribute knowledge to children and youth (Spring, 2005). The most common method of distribution is the formal lesson in which all students must be engaged. During mathematics lessons, most of the lower thinking level questions can be directed to the special education students in the class, thus allowing them to be actively engaged in lessons. Most of the higher level thinking questions can be directed to the regular students. The teacher must use skilled and professional judgment in determining where to draw the line regarding the type of student participation. Van Sciver (2005) stated that instruction, not content, should be differentiated.

In terms of achievement in mathematics for special education students, evidence suggests that quality and integrity of direct instruction must be studied, along with the differentiated instruction offered by the special education teacher and the classroom teacher in delivering the mathematics curriculum (Van Sciver, 2005). A good team approach in planning, teaching, assessment, and evaluation is crucial. During formal teaching or instruction time, instructional strategies must be modified to enable all students to access the content and demonstrate what they have learned (Cigman, 2007). Differentiated instruction is an inclusive approach to planning and delivering the mathematics curriculum that responds to the needs of individual students or groups of students by shaping the content, process, product, and learning environment. Instruction of this type is needed to enhance success amongst the special education student populace. Innovative teaching strategies offer them varied approaches to enhance their learning.

Alternative Learners

Modern education organizations contain alternative learners or special education students - with various exceptionalities. This student population deserves opportunities to develop to their fullest potential in all areas of the school curriculum. Marshall and Oliva (2006) stated that teaching is a form of social justice praxis. An area requiring further investigation is the impact of special education students' participation and engagement in mathematics and how teachers can increase these aspects. Schon (1983) stated that true professional practice has to do with recognizing, setting and fixing the problem.

Jacobs (2008) collected and analyzed the description of inclusion from teachers involved in implementing inclusion in the elementary school setting. The purpose was twofold: to discover the benefits and disadvantages of the inclusion of students with disabilities in the general education classroom, and to assess the attitudes of teachers toward inclusion. Some interesting facts were revealed, including the finding that teachers viewed inclusion as a beneficial approach to all students (with and without disabilities), as well as teachers. Findings also supported the use of differentiated instruction to maximize these benefits.

Research Approaches

A concurrent nested strategy was necessary to investigate the level of participation of special education students and regular students during mathematics lessons, the impact of increased participation and engagement in mathematics lessons on special education students, and how teachers can increase the level of engagement of special education students during mathematics lessons. Specifically, the qualitative study was nested within the quantitative study. A structured observation protocol was used in the quantitative portion of the study, and classrooms were observed to document interactions between teachers and students. The interactions were coded according to student group membership. For the qualitative portion of the study, a structured interview protocol was used. The campus principal and seven campus teachers were interviewed. Audio recordings were transcribed and used in the analysis.

According to Janesick (2004), listening must be used in collecting data. In the first stage, the researcher finds concepts and themes in the interview (Rubin & Rubin, 2005). Following these guidelines, I reviewed the interview transcript for themes and concepts. After identifying the themes, I returned to the interview for coding. The rationale for choosing the codes were based on the theme of the teacher (*t*), regular student in mathematics (*rm*), special education student in mathematics (*sem*), participation and engagement of special education students in mathematics lessons (*pesem*), and ways of increasing level of engagement of special education students during mathematics lessons (*wiesem*). In this study, the codes were abbreviations of the identified themes. After this process, I checked for two aspects: the fit of the data to the codes, and the utility of the codes to link each research question to the interview transcript.

For this study, the independent variable was the student group with two levels, namely the special education students and the regular students. The dependent variables were frequencies and percentages of classroom interactions during mathematics lessons. This study grew out of the emerging corpus of work within the quantitative methods traditions (Cohen & Manion, 1989). Results from the study are found in section 4. Due to the volume of data, some of the results are also presented in Appendices E, F and G.

Staff Development

From a historical perspective, effective leadership has been centered in student learning, student achievement, and ultimately social change (Marshall and Oliva, 2006). Evidence suggests that special education students must be provided with different approaches and opportunities to enhance their learning and to articulate the process (Cigman, 2007). During lessons, these students need to be routinely asked to clarify their thinking about mathematical ideas, using reading, listening, and viewing to interpret and evaluate mathematical ideas, discuss mathematical ideas, and make convincing arguments (Caldwell, 1995). All the theories, research results, theory-related observations, and the literature tend to support my hypothesis. If the right learning environment is provided, special education students are also capable of learning, even if in small increments at a time. The school board of the district where this research was conducted shares this philosophy, and its goal is to allow each student to learn and develop to her/his maximum potential.

Educators have the unique opportunity to continue to learn about the members of the communities they serve, both as members of their cultural communities and as individuals (Lindsey et al., 2005). Becoming familiar with the school and interacting with staff, students, and the community at large enables the leader to identify gaps that impede student learning and achievement. Understanding teacher development and thinking helps teachers grow professionally and helps school administrators facilitate and promote professional teacher development. Release time must be set aside for teachers to attend professional development activities, workshops, and conferences. School-supplied teacher days must be set aside for principals to accommodate these events. Ball et al. (2005) suggested that teacher learning must include additional mathematics content classes, extended mathematics institutes, lesson study, and collaboration with peers.

The school where this research was conducted began to operate as a Model II theory in action (Schon, 1983). Obtaining valid information from multiple sources, providing all stakeholders with the necessary data, increasing the commitments of the staff to decisions made, and creating favorable conditions for commitments to allow initiatives to be implemented are of major importance. The leadership style that would promote an optimal culture in the school is a transformative one. There is a need for reform—a need for the teachers to engage in professional development that promotes learning of teaching techniques, program modifications, and student learning profiles. Curriculum resources and textbooks must be revisited, and equipment and software programs in the school must be upgraded. Furthermore, the school's budget allocation needs to reflect priority in these areas.

Given the right conditions, special education students can learn and increase in student achievement. The administrator must be a key team player in this process. Learning the students' academic and behavior profiles will allow the leader to identify gaps. Thereafter, school improvement and action plans are developed regarding staff development programs, curriculum resources, textbooks, computer programs, software, extracurricular activities, and clubs. Another aspect to consider is the school facility, which can be maximized for effective implementation of the plan. Finally, the budget allocations and the school improvement plan need to complement each other.

It is the responsibility of educational administrators to examine these practices during informal classroom visits and formal teacher performance appraisals. Recommendations for teacher professional development need reflect suggestions for improvement, aligning them with the benefit of both the individual and the organization. According to Sergiovanni (2005), teachers and principals must determine how work will be done and how time will be spent while actually doing their jobs, in effect creating their practice in use. An area to be stressed, especially in the elementary panel, is quality instruction time in literacy and numeracy. Much research supported an increase in instructional time in mathematics (Jennings & Likis, 2005; Lalley & Miller; 2006; Parrett, 2005). In the organization where this study was conducted, excellent staff collaboration and morale prevailed, and it was regarded as a community of practice.

Knowledge and understanding of teacher development and thinking helps school administrators facilitate and promote professional teacher development in the required areas, including special education. One of these areas is numeracy. Staff development in mathematics education and teaching students with special learning needs is needed in many organizations. Good systems theories and change theories are needed to guide practice (Laureate Education, 2007). Systems theories explain how systems or organizations work. In a school system, when one thing is touched, everything else shifts (Laureate Education, 2007).

Excellent teacher leaders are found on most teaching staffs. These are the individuals who can be charged with duties and responsibilities. Such strategies will encourage and empower others to become leaders in a manner that will sustain the impetus toward equity, excellence, and learning of the organization. Teacher leaders can be assigned duties to assist the school administrators. This not only creates the opportunity for teacher leaders to get some experience in the area of school administration, but also allows time for the school principal and vice-principal to circulate the school and interact with the various members of the community of practice.

Staff professional development, collaboration among faculty members, and joint problem-solving will promote these elements within the organization. Equally important is for educators to have a vision and to lead the organization in the direction of excellence. Facilitating and promoting professional development of the staff needs to take first priority. These activities must always focus on student learning and achievement. The aim is to increase knowledge in teachers and students, improve professional application, and provide positive social change, ultimately resulting in social justice.

Schools are agents of positive social change. Society changes schools, and schools change society (Laureate Education, 2005). The most effective educational reformers are those who can respond to the current needs of their society. At the same time, the historical roots of the elements they seek to reform must be acknowledged. Teaching and learning, and ultimately improvement of student achievement, should be a school's goal (Spring, 2005).

Programming in Mathematics

Provided the opportunities are given and the right environment is set up, learning can occur and student achievement in mathematics can be increased for this marginalized group. Evidence from the literature, formal research results, theories, practitioner-based results, and theory-related observations are included throughout this study to support this hypothesis. Effective strategies for investigating and communicating research-based practices that result in improving teaching techniques and student learning need to be in place. Students all possess different learning styles and profiles. The goal is to build strong learning organizations in which all students, including special education students, can learn.

According to the Curriculum and Evaluations Standards for School Mathematics, one way to develop a deeper understanding of children's thinking involves analyzing mathematics as communication (NCTM, 1989). Ball, Cortese, Hiebert, and Kemble (2005) agreed that learning through problem-solving is a vehicle for understanding mathematics. Through best practices, the teacher finds the level of the students' understanding of mathematical concepts and re-teaches concepts proceeding from the known to the unknown. This allows them to construct knowledge one concept at a time. The special education students need to be actively involved in lessons and need to be called upon to elicit responses as well. Articulating their reasoning allows them to reveal their thinking process in answering questions and solving problems.

Other equally important reasons for actively engaging students during lessons are worth mentioning because they are grounded in pedagogical theory. The first is keeping students focused on the lessons. In mathematics, lessons are built on concepts and skills taught in previous lessons. Allowing opportunities for articulation of the process used to arrive at the final product is the second one. If students get the message after a few lessons that they are seldom or never going to get called upon for input and participation, then they might become passive or distracted during instruction and may not pay full attention to the lessons being taught. Key roles for teachers are delivering the curriculum, creating an environment conducive to learning, facilitating student learning, and evaluating their academic growth and achievement. There are several forms of social justice praxis, and teaching is one of them.

Mathematics Pedagogy

Piaget's theory of constructivism states that human beings acquire knowledge by building it from the inside instead of internalizing it directly from the environment. The construction from within can best be explained by reviewing the distinction Piaget made among three kinds of knowledge—physical knowledge, logico-mathematical knowledge, and social (conventional) knowledge (Kamii, 1987). Number is an example of logico-mathematical knowledge. In Piaget's theory, this aspect of knowledge is different from both physical and social knowledge. Physical knowledge is knowledge about objects in external reality and is acquired by observation. Social or arbitrary knowledge is knowledge that is built by social consensus. In logico-mathematical knowledge, children proceed in learning from concrete to abstract; it is rooted in sources that are mainly internal (in the individual) (Kamii & DeVries, 1977).

Whole-class instruction is teacher-centered and is commonly used to introduce new materials and strategies to the entire class (Valentino, 2007). When teaching concepts, the teacher plays a crucial part in maintaining the students' interest and motivation whether in a large group setting, small group setting, or on an individual basis. During any given mathematics lesson, the teacher should keep in mind appropriate and effective questioning techniques. Special education students can and must be actively engaged in lessons, regardless of the mathematics strand being taught. Classroom expressions that help the student participate in the learning process must be considered. This must be modeled by the teacher during direct and indirect teacher talk, explanation of sample problems, and questioning techniques.

Increased academic instructional time promotes achievement (Bukas & Pattison, 2006; Fratt, 2006; Parrett, 2005; Reeves, 2006; Royal, 2007). According to Scheffler's Rule Model, the teacher should have some kind of insight about which activities to choose depending on the nature of the lesson and the students' abilities. Equally important is facilitating the conversation of instruction so that students are allowed to give reasons, listen to each other's reasons, follow the lesson, and gain insight (Scheffler, 1965). Regardless of the mathematics strand being taught, the teacher knows the pedagogical content he/she wants transformed and therefore must know when to interject and ask more questions, to allow for clarification and monitoring the progression of the lesson. In the patterning and algebra strand, for instance, even though the abstract concepts of algebra may be difficult for some students to grasp, recent studies stated that there are great benefits to learning algebra earlier (Fratt, 2006; McCoy, 2005; Spielhagen 2006).

Using the basic pedagogy model, a teacher assesses a student's learning on three different levels: understanding, consolidating, and reflection and reasoning (Shulman, 1987). Each stage is clearly identified by specific characteristics. At the understanding level, students can articulate the concept, recite it, and proceed from the concrete stage to the symbolic stage. At the consolidating level, they have a clear understanding of the concepts and can do drills, games, exercises, practice questions, and so on. At the reflection and reasoning level, they can apply skills to word problems. They can give or articulate logical reasoning of why they attacked the problem as they did and why they chose a particular solution strategy. The students are also able to follow Polya's steps. They can solve the problem, check the solution, and look back to see if the solution and the final answer are reasonable.

One aim of mathematics instruction is to allow students to experience mathematics in ways actually used in the real world (Ebby, Ottinger, & Silver, 2007). It is important that teachers use physical materials, diagrams, and real-world situations in conjunction with ongoing efforts to relate their learning experiences to oral language symbols. Articulating the process is crucial in the teaching/learning process (Kamii & DeVries, 1977). Even in cases where the student did not understand the process, or where confusion persists, this method of instruction allows the teacher to analyze student answers and pinpoint the breakdown of the student's understanding of concepts and skills. It provides the opportune time for the teacher to take the student aside and, through scaffolding, conduct mini-lessons to help the student reach the next level of understanding. Probing is essential to diagnose where the errors/limits of the student's understanding of the process and content lie, to redirect them and to reprogram for them.

This issue permeates every classroom, in every school, in every community. In this age of vast information and technology, educators can take advantage of globalization to advance the mission of social change in their organization or community of practice. Research study results on topics such as this are readily available. Studying philosophies, theories, and research from other nations can extend knowledge among leaders so they may begin to integrate new ideas for reform into their thinking (Laureate Education, 2006). Individuals may share and inspire through knowledge of teaching, learning, and leading, and ultimately connect with the global community (Laureate Education, 2006). Through peer networking, ideas that work in the classroom along with best practices can be readily shared with educators on the other side of the globe, thereby providing opportunities for discussions about their effectiveness. Steve Anderson stated that it is important to break down barriers between organizations, communities, and countries (Laureate Education, 2006).

Summary

Creswell (2003) stated that a study adds to scholarly research and literature in the field and helps improve practice. The goal is to aim for best practices at every level of the learning organization for the improvement of student achievement. This research study added to the field of education by extending knowledge about whether the special education students' degree of improvement in achievement in numeracy is due to their learning styles and profiles alone or if instructional techniques are added factors. It provided school principals/administrators with advice for observation sessions during teacher performance appraisals. Teacher work, if examined carefully, reveals many dimensions of the classroom culture and the learning and teaching that happen there (Weinbaum et al., 2004). On a larger scale, it provided me with awareness of deficiencies in instructional techniques and classroom management.

Students must be well prepared because they will become members of the next working society. Experts, for instance, are beginning to worry that some American students do not have the mathematics skills needed to keep America's workforce strong (Freirweiss, 2006; Langham, Sundberg & Goodman, 2006; McCoy, 2005). This study provided the foundation for educational reform and has the potential to make a positive difference in the field. The aims of this study were to provide suggestions for improved methodology of teaching mathematics to special education students, promote positive social change for this deserving student population, and create social justice for them. The ultimate goal is to increase opportunities for improvement in student achievement in mathematics for this marginalized group. Learning to teach better involves more than implementing other people's ideas.

In order to achieve this goal, schools need to work with each one of these students. Special education students deserve to develop to their maximum potential in mathematics, especially since it is one of the main focuses in the school curriculum. On a larger scale, our education systems should be working toward creating a better educated and prepared generation in numeracy, so it can function efficiently and effectively in the future. Very few careers do not require basic mathematics skills, and the job market has ever-increasing demand for technical skills (Noel-Levitz, 2005). If schools are to provide a positive future for all the students in the education systems to the extent that they are able, then social justice is necessary for all of them, including special education students.

This section has provided a thorough literature review for this study. The study is grounded in this relevant literature and in theories articulated herein. In section 3, the methodology section, I outline and discuss the research designs and the methodology. A mixed methods approach was used. I also describe and explain the various data collection tools used in the study.

Section 3: Research Method

In this study, with Institutional Review Board approval number 04-21-10-0346601, a mixed method concurrent nested strategy was used to help determine the impact of special education students' participation and engagement in mathematics and how teachers can increase their level of engagement during mathematics lessons. The rationale for selecting a mixed method strategy is that the qualitative method is nested within the quantitative method (Creswell, 2003). Concurrent procedures were employed in which qualitative and quantitative data were used to provide a comprehensive analysis of the research problem. There was one data collection phase, during which both quantitative and qualitative data were collected simultaneously; therefore, they are considered two approaches or two steps in a single study. The embedded method addresses a different question than the dominant method (Creswell, 2003). A mixed method study acknowledges that both qualitative and quantitative approaches are needed to explain the relationship of the concepts and findings (Laureate Education, 2005). Given that this is a mixed methods study, the data collected were mixed during the data analysis phase (Creswell, 2003).

Through the case study design, qualitative data were collected through a structured interview protocol. The interviews were then transcribed and analyzed. This study employed two methods for collecting data: an administrator interview and a teacher interview. Specific instruments were designed to gather qualitative data on the demographics of the school, the personal interests of the teachers, the ways high participation of special education students in mathematics impacts the students, and successful teacher practices to increase the level of special education students' engagement in mathematics. Interview templates are found in Appendices A and B.

The data were gathered for both the structured observations and the structured interview protocol. To obtain valid and reliable data, I had to get feedback from the selected groups. All the interviews were later transcribed and commonalities that stood out were coded. Following this process, charts were set up ahead of time to record the interactions between the teacher and the regular students as well as the teacher and the special education students. With consent by the school principal and the teachers, I visited the classes on different days, and I held meetings at regular weekly intervals to discuss the data with the teachers.

This study strictly involved a population of 375 students, both female and male, with varied mathematics abilities and functioning levels. Approximately an equal number of participants were represented from Grades 9 to 12 inclusive, given the fact that there was an even distribution of course levels and classes in every grade level. The quantitative study was a pre-experimental design. Separate data were collected for the qualitative part. Upon completion of both parts of the study, the data collected from the two methods were mixed during the analysis phase (Creswell, 2003). The method grew out of the emerging corpus of work within the quantitative methods traditions (Cohen & Manion, 1989), with the study bound by time and activity (Creswell, 2003).

Research Questions

Three research questions were addressed in this study. The first asked what the level of participation of special education students and regular education students is during mathematics lessons. The second asked what the impact of increased student participation and engagement in mathematics lessons is on special education students. The third asked how teachers can increase the level of engagement of special education students during mathematics lessons. Results are structured around the research questions, answering each one at a time with pertinent data.

Rationale for Paradigm

In this study, my goal was to assess the extent to which social change is necessary to improve special education students' achievement in mathematics. The study investigated the impact of special education student participation and engagement in mathematics in an attempt to improve educational practice in the day-to-day teaching environment. Ultimately, the goal was to identify successful teaching practices of teachers to increase the level of special education students' engagement in mathematics. Themes that were coded and aligned with the research questions and that focused on observed interactions between teachers and students were identified in the qualitative portion of the study. Data from the two portions were amalgamated during the data analysis and interpretation part of the study.

Research Design

The design for this study involved data collection from teachers and one school administrator using structured interview protocols. Observations were made during regular mathematics subject classes/periods. Simultaneously to the observation sessions, audio-recordings of classroom sessions were conducted during mathematics lessons. Tools were set ahead of time to record the data collected. Regular meetings were scheduled with the teachers and the principal to ensure that the data collection instruments were being used correctly. Complete summaries of the data appear in tables throughout section 4.

Materials required for this study included paper, pencils, clipboards, audiotapes, a tape recorder, interview logs, observation logs, and tally sheets. Interviews were recorded and transcribed. Transcripts, field notes, and classroom schedules were also used in the study. An interview protocol was used for recording information during the interviews—a heading, instructions to the interviewer, the key research questions, space for recording the interviewee's comments, and space in which to record reflective notes (Creswell, 2003). Sheets containing a list of questions the interviewer asked each teacher and the school administrator were available to the interviewees during their respective interviews. The specific questions for the inquiry will be analyzed in section 5 using the data collected from both the quantitative and qualitative portions of the study.

The interview session involved interviews with both teachers and the school principal, each with their own set of interview questions. Obtaining information from teachers about questioning techniques they used was vital to the study. Equally important was examining the influence of the teachers' background on questions formulated during lessons. I asked teachers a variety of questions, including ones on their personal and professional background, along with their level of involvement with special education students in their regular mathematics lessons (see complete list of interview questions in Appendix B). I asked the principal a variety of questions as well, including his viewpoints on the placement model for special education at the school, the demographics of the student body, and the accommodations available for special education students (see complete list of interview questions in Appendix A).

Responses to these questions revealed important information. Qualitative interviewers listen to hear the meaning of what interviewees are telling them. When they cannot determine the meaning, they ask follow-up questions to gain clarity and precision (Rubin & Rubin, 2005). The interviewer must possess good probing skills to clarify any ambiguity in the responses, and must use good judgment to determine the limits of probing. Information gathered from the questions allowed for a rich analysis. I followed these guidelines in my interviewing work to ensure the credibility of my findings.

Methodology

Population

According to Cohen and Manion (1989), good data collection procedures start with the total population and works down to the sample. Careful sampling procedures were followed to ensure that the sample chosen for this study was representative of the population. This particular group was composed of approximately equal numbers of male and female students who represented various grade levels in the secondary school panel. These students possessed a variety of learning styles and profiles. According to recently administered academic assessments, the special education students were all functioning at different grade levels in mathematics.

Sampling Procedures

The sample is the small circle within the population (Laureate Education, 2005). Included in the population were regular and special education students who were receiving special education support and services in mathematics. In these grade level courses, the ratio of special education students to regular students was approximately 1:6. This pre experimental design included students in various classes from Grades 9 to 12 inclusive, and they remained consistent for the duration of the research to allow for solid data collection. For sampling procedures, classes of teachers who consented to interviews and observations during their mathematics lessons were selected. One criterion that determined the eligibility for the teachers was that they were teaching an applied level, open level, or essential level mathematics course for the current academic year.

Participants

The first part, the quantitative study, was a pre experimental design. This study involved a population of 375 students, both male and female, in different grades and course levels in a high school. All classes contained regular students and students who were receiving special education services and support in mathematics. Martel (2006) hypothesized that students have shown that instruction is effective only when matched to the knowledge, skills, and performance levels.

Participants in the quantitative part of the study were selected through purposeful sampling, and those in the qualitative part were chosen through convenience sampling. The participants in the qualitative part represent seven classroom teachers and one school administrator. The school administrator was a school principal with 26 years of experience in both teaching and administration in the secondary school panel and extensive knowledge of this community of practice. Teacher participants were certified teachers with varied academic backgrounds and interests and varying years of teaching experience. The student participants were regular students in Grades 9 to 12 and special education students who were receiving special education support and services in the subject area of mathematics.

The subjects involved in this study were integrated in the regular mathematics courses. For the qualitative part, using the case study tradition, the same technique was used intensively with one group of teachers. The students observed represented a fairly even distribution throughout the grades and courses involved. In the quantitative part of the study, the participants were chosen by purposeful sampling. Volunteer teachers were chosen by convenience sampling in the qualitative part of the study.

Instrumentation

Instruments were used to collect data for the quantitative and the qualitative portions of the study. Because a concurrent nested strategy was used, the qualitative part of the study was done concurrently with the quantitative part. For the qualitative portion, structured interview protocol was used. The questionnaire was directed to the school principal and served to identify demographic information about the school as a community of practice. The interviews with the teachers investigated the level of participation of special education students and regular education students that occurred during mathematics lessons, the impact of increased student participation and engagement in mathematics lessons on special education students, and how teachers can increase the level of engagement of special education students during mathematics lessons.

The quantitative part of the study had both independent and dependent variables. More specifically, the independent variable was the student group with two levels—the special education students and the regular students. The dependent variables were the frequencies and percentages of classroom interactions during mathematics lessons. A structured observations protocol was used. Classrooms were observed to gather interactions between teachers and students. Observations were coded according to student group membership.

Data Collection

Observations and interviews were used to collect data. The interviews had conversational, open-ended formats (Creswell, 2003). The first set of interviews was held with the teachers and focused on questions related to the impact of increased student participation and engagement in mathematics lessons on special education students and how teachers can increase the level of engagement of special education students during mathematics lessons. A separate interview was held with the principal to gather information on the school culture and demographics. All interviews were audio-taped and transcribed. Research questions were drafted ahead of time and response sheets were set up to record responses from the participants. Data collection sheets and labeled tapes of audio-recordings were kept and catalogued and will be made available upon request.

The student data were gathered strictly through structured observation protocol or audio-recorded sessions, and used no coercion to teachers or the principal to participate. Audio-recordings were conducted during various mathematics lessons delivered by different teachers. Strategic scheduling of audio-recording sessions allowed for data collection of lessons with a variety of concepts taught in the different mathematics strands. The introduction and development parts of every lesson contained sound teacher-student dialogue. In addition, appropriate duration of each and every mathematics lesson permitted a thorough analysis of the data collected.

In this study, there were internal and external validity threats. Internal validity threats were absence of special education students, teachers' refusal to participate in the study, the participants' degree of willingness and honesty to reveal their personal background and interests, my biased experiences as the researcher, and the lack of transferability of findings. Another validity threat was my inability to draw casual inferences from the data (Creswell, 2003). External validity threats arise when incorrect inferences are drawn from the sample data to other participants and settings. (Creswell, 2003). These would include teachers in other assignments such as those teaching academic level mathematics courses, as well as those teaching other subjects or courses.

Qualitative Sequence

The forms, interviews sheets, observation logs, and other protocols were set up ahead of time, as were the assent forms, in order to allow adequate time for teachers to complete and return them. This research employed multiple methods of data collection, was emergent, was based on my interpretations, was viewed holistically, and was reflective (Creswell, 2003). Interviews, including observations of participants during interviews, were used for the qualitative study. All these information items shared equal importance. Classroom observations also included an initial visit to observe the setting and learning environment.

The qualitative part involved a school demographics administrator questionnaire and teacher interviews. There were a total of seven teacher interviews (four female and three male teachers). I scheduled initial classroom visits to observe each classroom setting. Following this step, and using the same teacher interview questions, one interview was completed each day with a different teacher. All the teacher interviews took place before or after school, depending on the convenience and the availability of the teachers. Responses for the interviews were coded into four categories: topic or concept was always integrated in lessons, often integrated, rarely integrated, or never integrated.

Protocols were set up ahead of time to facilitate data collection. Forms included the date, time, and location of the interviews, names of the participants, and my notes as an interviewer. A brief section on my reflections as an observer, including non-verbal behavior of participants, was included on the teacher and principal interview forms. Separate forms were used for each teacher interview and the principal interview. The protocols were color coded for sorting purposes.

Quantitative Sequence

The quantitative part of the study had both independent and dependent variables (Gravetter & Wallnau, 2005). The independent variable was the student group with two levels, the special education students and the regular students. The dependent variables were the frequencies and percentages of classroom interactions during mathematics lessons. A structured interview protocol was used. Classrooms were observed to gather interactions between teachers and students, and the observations were coded according to student group. Data collected from the qualitative and quantitative portions were amalgamated during the data analysis and interpretation part of the study.

Data Analysis

Data analysis is an ongoing process during research (Creswell, 2003). It logically and sequentially addressed all research questions. Since this is a mixed methods study, data analysis was required for both the qualitative and the quantitative data. For the qualitative part, the interviews were audio-taped and transcribed. Following this, key phrases were identified (Laureate Education, 2005) and documented, and a tally was developed to track the number of times the key phrases were used. Transcripts and field notes were also used in the study.

Each set of interviews, namely the teacher and principal interviews, had its own codes. A coding system was developed to locate and identify the participants' responses, and they were then numbered by transcript, page, and line. Analysis of the interviews using inductive content analysis or protocol analysis was used. Teachers' responses to the interviews were separated and coded into four categories with respect to their interests influencing topics infused in the development part of mathematics lessons (highly influenced, influenced, moderately influenced, and not influenced). Commonalities that stood out were noted and summarized. Qualitative analyses were used and were clearly linked to the data. The study focused on findings and commonalities between teacher interests and topics used in mathematics lessons, as well as on finding links between these and frequencies of participation and engagement of special education students in the lessons.

Each research question had its own data analysis plan. In the quantitative portion, descriptive statistics, including number of teacher/student interactions for each group, frequencies, and percentages, all addressed Research Question 1 (RQ1).

In the qualitative portion of the study, text analysis of transcribed interview data coded for themes addressed Research Question 2 (RQ2). The same data analysis addressed Research Question 3 (RQ3). Research Question 3 also involved qualitative data.

The aim was to investigate what the levels of participation of special education students and regular students were during mathematics lessons. For RQ1, the purpose was to examine the frequencies and percentages of classroom interactions during mathematics lessons by eliciting responses to teacher-directed questions. The study also aimed at determining the impact of increased student participation and engagement in mathematics lessons on special education students and how teachers can increase their level of engagement. For this question, the purpose was specifically tied to the questions asking for examples of successful practices of teachers to increase the level of special education students' engagement in mathematics. Ultimately, the goals were to identify successful teaching practices of teachers to increase the level of special education student engagement in this subject area and to improve educational practice in the day-to-day teaching environment.

Summary

Research ethics involve the responsible conduct of research. Other aspects involve the protection of the participants, integrity and respect of the editorial process, and the recognition of other people's work (Laureate Education, 2005). The human subjects in this research were studied responsibly and ethically and all had the option of declining participation at any point throughout the study. However, there were minimal threats or risks to the subjects involved. For ethical reasons, the students and teachers who took part in the study were not identified. The students in the classes involved were informed that a study was being conducted, and that they were not going to be identified in any way. The parties involved were told very clearly that they could withdraw at any time or decline to participate in any part of the procedure without jeopardy.

Upon completion of data collection and analysis, it was important for me to reflect on several main aspects. The first was to ensure that the study had answered the questions asked. The second was to check for substantiality and credibility of the data collected. Finally, the third was the application of the study to the larger arena. This would imply suggestions for further study.

Of importance also was determining the way the findings would reform teaching and learning in this area (Schon, 1983), therefore advancing the betterment of society at large. A narrative format is used to report the findings. The goals of the study were to improve educational practice in our elementary panel—a main learning community, to improve student achievement for all special education students regardless of their backgrounds and interests, to bring about positive social change, and to make a contribution to the field of education. It aimed for positive social change by identifying the impact of increased participation and engagement of special education students in mathematics lessons and how teachers can increase their levels of engagement in these lessons. This may lead to a better understanding of how to keep students focused, possibly leading to improved achievement in this subject area.

Transition Statement

Section 4 of this study includes completed charts with respective totals and percentages, graphs, analysis of the results, and an essay commenting on the study and corroborating the material gathered from external documentary sources. A theoretical essay evaluating the linkage of the study conducted herein and how the findings will be operationalized is presented. Suggestions for improvement are provided on a system-wide scale, for the school level, the board level, and the education system at large. Recommendations will focus on positive social change and social justice for these students. The goal is to better prepare them for modern society.

It is important to determine how the findings will reform teaching and learning (Schon, 1983) and how they will help improve student achievement in numeracy. Schon (1983) stated that people look to professionals for the definition and solution of our problems. It is through them that society strives for social progress (Schon, 1983). This is another step toward constructivism. The study may provide substantial data that may require special education policies and procedures implemented by school boards to be revisited. Better servicing special education students is the focus.

Furthermore, the study lends itself to great importance by generating knowledge, professional application, and social justice. It aims for positive social change by identifying the impact of special education student participating and engagement in mathematics lessons. In turn, this may lead to identify more effective instructional techniques that teachers can adopt in the classroom to increase levels of special education students' engagement in mathematics lessons. Educational institutions need to provide the brightest future for all the students in the system, including the special education students, to the extent that they are able. The goal is the betterment of this group.

Section 4: Results

The main objective of this study was the achievement gap in mathematics for special education students. It aimed at investigating the impact of special education students' participation and engagement in mathematics. A mixed method concurrent nested strategy was used in which the qualitative method was nested within the quantitative method. Concurrent procedures were employed in situations in which qualitative and quantitative data were used. Data from the two methods are amalgamated in this section. Tables and graphs will display summaries of the results. Integration also occurs in this data analysis to answer the three research questions.

Data were collected through observations of classroom sessions, audio-recordings of classroom sessions, and interviews. In selected cases, classroom observations were conducted along with the audio-recordings to record field notes of teacher-student interactions and the dynamics of the class during the lessons. All mathematics lessons were audio-recorded and later transcribed. Selected excerpts of the transcripts were converted to narratives and are reported throughout this section to support the points and arguments presented. The principal and teacher interviews were conducted one-on-one, audio-recorded, and transcribed.

Each component of the data collection and analysis phase focused on a different aspect. Classroom observations emphasized the effectiveness of these interactions given the dynamics of the student group. Another aspect of data collection was the mathematics lessons audio-recordings, which emphasized the frequency of teacher-student interactions and focused particularly on the special education students. The principal interview emphasized demographic information about the school and this community of practice. Teacher interviews were conducted and emphasized the impact of special education students' participation and engagement in mathematics lessons and what teachers can do to increase them.

This study involved one school principal and mathematics subject teachers in one high school in southern Ontario, Canada. Also involved were students in one high school who are currently enrolled in different level mathematics courses—locally developed, essential, open and applied. For confidentiality, the principal's and teachers' names and the mathematics courses were coded. A coding system was developed (principal (*p*), male teachers (*tma, tmb, tmc*), female teachers (*tfa, tfb, tfc, tfd*), and mathematics courses (IA, IB, IC, ID, IIA, IIB, IIC, IID, IIIA, and so on). Codes were also developed for students whose names were transcribed from tapes of the audio-recorded sessions and used as examples in the narrative of this section (Student A, Student B, and so on). Other codes used are regular students in mathematics (*rm*), special education students in mathematics (*sem*), participation and engagement of regular students in mathematics (*perm*), participation and engagement of special education students in mathematics lessons (*pesem*), and ways of increasing engagement of special education students in mathematics lessons (*wiesem*).

Research Question 1

Research Question 1 asked, "What is the level of participation of special education students and regular education students during mathematics lessons?" Observations and audio-recordings were used to answer this question. The observations sessions were conducted during the entirety of the mathematics lessons, including the introduction, development, and extension parts. This type of data collection allowed observations of student-teacher talk and interactions to be collected throughout the duration of the lessons. Audio-recordings documented the progression and flow of the lessons.

Observations. The classroom session observations provided opportunities to observe the dynamics of the classes and to make field notes that could otherwise not have been gathered through audio-recordings. Strands covered during the observed lessons were geometry and spatial sense, measurement, data management, probability, number sense, and numeration. Table 1 summarizes the mathematics strands covered in observed lessons. Various concepts and skills were taught during the mathematics sessions. Teachers reviewed and recapped the previous day's lesson and progressively proceeded into the next lesson. There was a noticeable, consistent pattern except in two lessons in which the teacher started a totally new unit of study. Examples were given by the teachers in the development part of the lessons to reinforce concepts and skills, which allowed for active student participation and interaction.

The classroom session observations provided data and information for both the quantitative and the qualitative portions of the study. Engagement of the students involved activities such as sharing ideas, writing answers on the board, articulating their reasoning, small group work, and presentations, culminating in analyzing data and drawing conclusions from the data for their behalf. Interestingly, most of the teachers emphasized Polya's steps with regular students (read and understand, plan, do, check) but not with the special education students. These anecdotes served to supplement and clarify the quantitative data. In-depth discussions and analysis of this aspect will be presented in section 5. A graph displaying the data appears below.

Series 1 and Series 2 in Figures 2 and 3 below refer to regular students and special education students respectively.

Table 1

Mathematics Strands Covered in Observed Mathematics Lesson Sessions

Observation Session	Number Sense and Numeration	Measurement	Geometry and Spatial Sense	Patterning and Algebra	Data Management and Probability
1	x				
2	x				
3			x		
4					x
5			x		
6	x				
7		x			
8		x			
9				x	

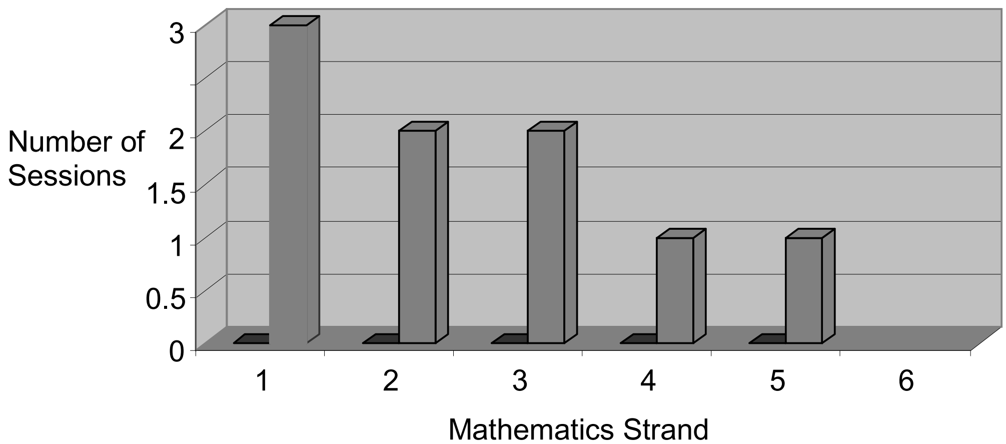

Figure 1. Mathematics strands covered during observed sessions.

Figure 1 illustrates the mathematics strands covered during observation sessions. Strands 1, 2, 3, 4, and 5 represent number sense and numeration, measurement, geometry and spatial sense, patterning and algebra, and data management and probability. Although there was a representation of all mathematics strands, the most common strand observed was number sense and numeration. The least common strands were patterning, algebra, data management, and probability. All lessons progressed from the known to the unknown and involved various concrete materials and pictorials to support learning.

The classroom session audio-recordings yielded transcripts of mathematics lessons infused with topics focusing on different concepts and skills in the mathematics strands. Audio-recorded lessons included mathematics lessons with an array of topics. Mathematics lesson topics included graph plotting, height of structures, equations, geometry, tan and tangent ratio, tan *x*, measurement of height, measurement of height of structures using clinometers, and so on. These data were supplemented by observations and field notes gathered during this concurrent approach and recorded on the Interactions during Mathematics Lessons Forms. Each lesson was recorded on a separate form for tracking and referencing purposes. The forms served as data records for tallies, percentages, and frequencies for the quantitative part of the study.

The quantitative portion of the study focused on descriptive statistics. This included the number of teacher/student interactions for each group, frequencies and percentages of classroom interactions during mathematics lessons in terms of responses to teacher-directed questions. Gathering the number of observed interactions between teachers and students was the objective of this portion. The independent variable was the student group with two levels—the special education students and the regular students. Due to the even distribution of special education students in the various courses, good data collection, in turn leading to solid data analysis was possible.

In addition to the independent variable, this portion also included dependent variables—the frequencies and percentages of classroom interactions during mathematics lessons. Observations involved recording the number of times each of the student groups interacted directly with the teacher in responding to teacher-directed questions (see Appendix C). Mathematics lessons observed in every grade and course level were highly interactive, including substantial blocks of student-teacher dialogue and allowing for participation of both the regular and special education students. All mathematics lesson transcripts were extensive and well developed, and some included opportunities for students to move on to the extension part of the lesson before the end of the lesson, thus enriching the transcripts and the quality of gathered data. Allowing the students to start working on assigned questions gave them the chance to ask questions pertaining to those questions and problems.

In Figure 2, Series 1 represents the regular students in mathematics and Series 2 represents the special education students. The variables on the horizontal axis, I, II, III, and IV, represent the grade levels in which the mathematics lessons were observed. These correspond to Grades 9, 10, 11, and 12. There was a fair and even distribution of special education students in all the grade levels. Data collection from all mathematics courses was made possible through consent and collaboration obtained from the school principal and all the mathematics subject teachers at the site. An ongoing observation log was kept to note classroom interactions between the classroom teacher and the regular students and the classroom teacher and the special education students. These data were recorded on the Teacher Student Interactions during Mathematics Lessons Form (see Appendix D).

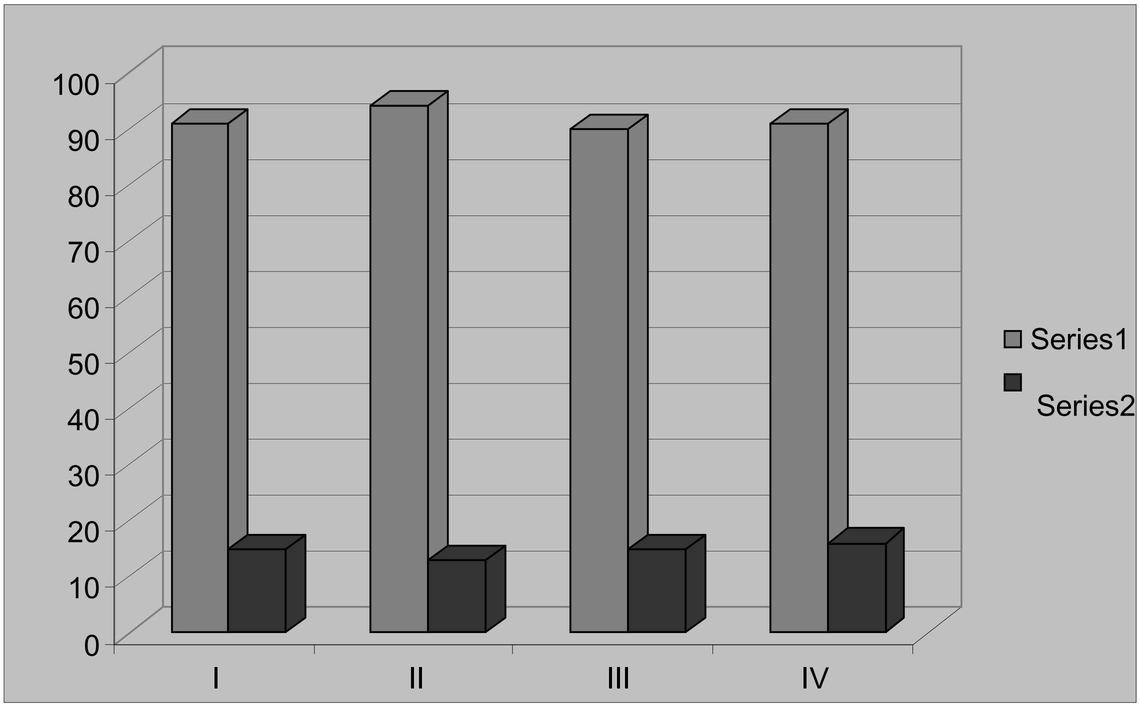

Figure 2. Number of regular versus special education students in mathematics per grade level.

In Figure 3, Series 1 represents the regular students' participation in mathematics per grade. Series 2 represents the special education students' participation in mathematics lessons per grade. The variables on the horizontal axis, I, II, III, and IV, represent the grade levels in which the mathematics lessons were observed. These correspond to Grades 9, 10, 11, and 12. Again, there was a fair and even distribution of special education students in all the grade levels.

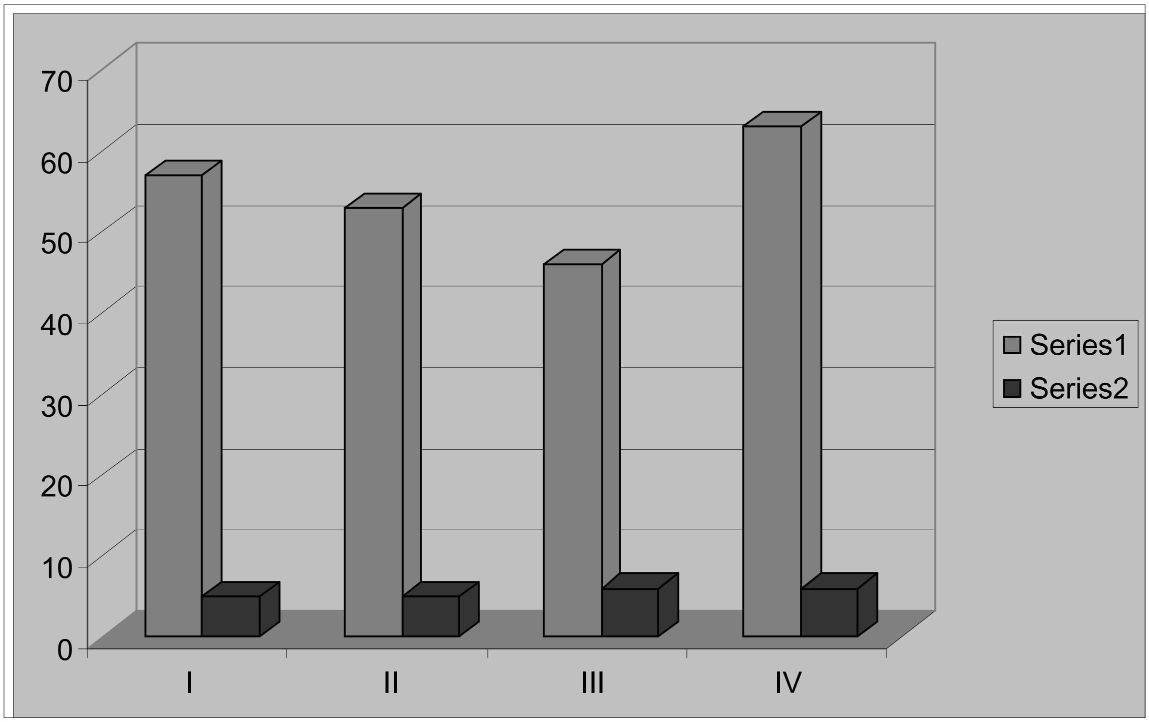

Figure 3. Regular versus special education students' participation in mathematics lessons per grade.

Table 8 in Appendix E displays the first round of data collection and includes teacher-student interactions during the first mathematics lesson sessions per course. The second round of data collection, which includes teacher-student interactions during the second mathematics lesson sessions per course, is displayed in Table 9 in Appendix F. As an amalgamation and summary of the data, Table 10 in Appendix G displays the total teacher-student interactions per course during the two mathematics lesson sessions. All raw data for the two sessions are displayed in Tables 8 and 9.

Table 10 displays the combined calculated data along with the percentage values. Calculations and analysis of the data revealed that special education students in mathematics are called upon almost half as often as they deserved. Data collected in some of the sessions clearly indicate that active engagement for these students in the lessons was minimal. Graphs provided later in this section illustrate these findings. This is indeed an area that merits further attention and investigation; it will be discussed in depth in section 5.

For this and other tables, *ts* is total students, *rm* is participation and engagement of regular students in mathematics, and *pesem* is participation and engagement of special education students in mathematics. Similarly, *prm* is percentage of regular students in mathematics, *psem* is percentage of special education students in mathematics, *sem* is special education students' mathematics, *tpm* is total number of student participation and engagement in mathematics, *perm* is participation and engagement of regular students in mathematics, *pprm* is percentage participation of regular students mathematics, and *ppsem* is percentage participation of special education students in mathematics. Classes A, B, and C refer to different classes within the same grade level. All the codes were developed to fit the research questions. The codes in the tables vary according to the data therein.

Table 2

Average Percentage Values of Student Type versus Participation in Mathematics Lesson Sessions

Calculated Data Value	Pie Graph Code	Percentage
prm	1	86.2
psem	2	13.8
pprm	1	91.5
ppsem	2	8.5

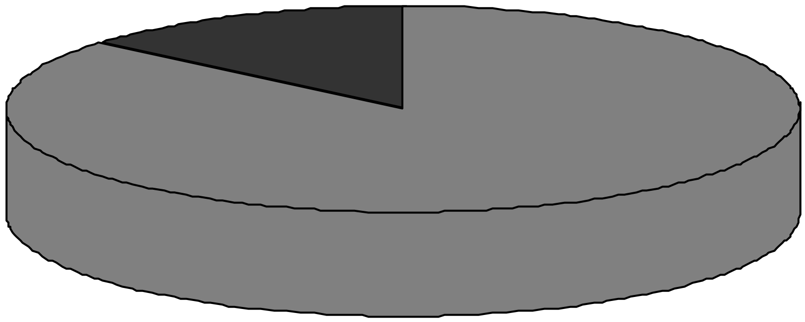

Figure 4. Percentage average of regular versus special education students in mathematics course levels.

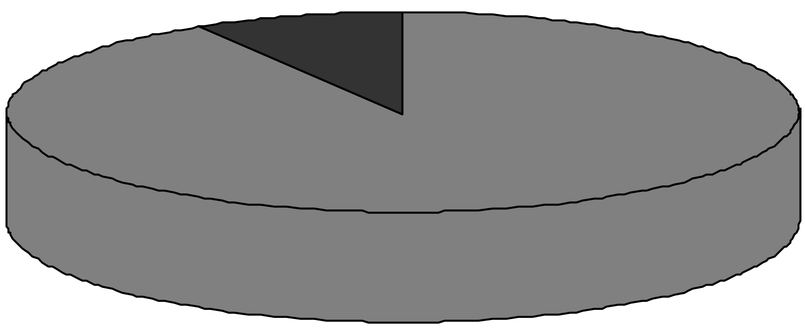

Figure 5. Percentage average of participation of regular versus special education students in mathematics level courses.

In Figures 4 and 5, the gray portion on the pie graph represents Series 1, which is regular students in mathematics. The black portion on the pie graph represents Series 2, which is special education students in mathematics. An aspect worthy of noting is that the grey area in Figure 5, corresponding to participation of regular students in mathematics, is larger than the grey area in Figure 4, which is the percentage average of regular students in the mathematics courses. It is evident from the same pie graphs that the percentage average of participation of special education students in the mathematics level courses is smaller than the percentage average of regular students. Again, Series 2 in Figures 4 and 5 clearly demonstrate these results.

Analysis of the data reveals that special education students in mathematics are not being called upon proportionately as often as the regular education students are. Throughout the lessons, the level 3 and 4 questions were being answered by the regular students, as were most of the level 1 and 2 questions. Another observed situation in which special education students were deprived of these opportunities occurred during lessons in which the teacher did not call upon students to elicit responses, but allowed them to randomly call out the answers. The regular students who could follow the lessons called out most of the answers. Interactions of this nature were observed in a few mathematics lessons. Special education students eventually lost track of the lesson, which led to passivity and distraction.

Table 3 summarizes the level of understanding of concepts taught in the various mathematics strands. The classroom observations and audio-recording sessions allowed for all strands in the mathematics curriculum to be observed and taped. There was also a fairly even distribution of male and female teachers and students. Most of the students achieved level 1 of understanding, and some achieved level 2, which are confusion or no understanding and partial understanding, respectively. It was interesting that no students achieved levels 3 or 4 of understanding, which are substantial and full understanding.

Table 3

Level of Understanding of Concepts Taught in the Various Mathematics Strands

Student	Mathematics Strand	Teacher	Student	Level 1	Level 2	Level 3	Level 4
A	NSN	F	F	X			
B	M	M	M	X			
C	NSN	M	M	X			
D	PA	F	M	X			
E	GSS	F	M	X			
F	GSS	F	F	X			
G	DMP	F	M		X		
H	NSN	M	F		X		
I	M	M	F		X		

In summary, results indicate that most teachers exercise best practices in terms of curriculum delivery in mathematics. However, fairness in regard to active participation and engagement of special education students during the lessons is an issue. These students are not being called upon enough to elicit responses to teacher-directed questions. Evidence of this lack of participation is clear in the data in the tables, charts, and graphs in this section and the respective appendices. Furthermore, the frequency and percentage values calculated confirm this lack of participation.

Audio-recordings

When the question or problems involved several steps, the teacher used a different strategy. The students were asked to write down their answers before starting to explain their thinking or rationale used to arrive at their final answer. This seemed to produce better thought-out answers. When students were called on to answer the questions and the problems, they were better able to articulate the steps used to answer the questions and the process used to solve the problems. This technique seemed to reveal more about their understanding for both groups of students. Therefore, the results and analysis contained herein encompass both the oral responses from the audio-recordings and the written responses noted and gathered from the observations sessions.

The classroom session audio-recordings allowed for tracking the exact number of student-teacher interaction with the regular student populace and the special education student group. Another aspect clearly recorded were the rather long pauses by the special education student before eliciting a response to teacher-directed questions. Also evident from the audio-recordings were the probes by the mathematics classroom teachers to clarify answers provided by the special education students to determine their level of understanding and to help gauge the flow of the lessons. Both these aspects occurred rather frequently through the data collection phase. Data obtained from the classroom observations and the audio-recordings complimented each other and enriched the analysis of the data.

Research Question 2

Research Question 2 asked, “What is the impact of increased student participation and engagement in mathematics lessons on special education students?” Audio-recordings and interviews were involved in the data collection phase of this concurrent nested strategy to answer this question. The audio-recordings included mathematics lessons in all five mathematics strands. Classroom sessions were audio-recorded at various grade and course levels. Data from the principal and teacher interviews were also required to answer Research Question 2.

Audio-recordings. The classroom session audio-recordings revealed that teachers delivered the mathematics lessons using strategic questioning and probing to clarify student responses and determine the level of proximal development of the students. Teachers posed questions and the students were randomly called upon to answer. For questions involving more than one step to arrive at the final answer or problems involving multiple steps to arrive at the solution, regular students were asked to articulate the process used to arrive at the final answer. When it came to lessons in the number sense and numeration strand, the regular students were engaged in the study through answering teacher-directed questions and then clarifying the process used to arrive at the final answer. An observation worth mentioning was that during lessons in the measurement strand, the regular students were again asked to make convincing arguments about their answers. Some could do so independently, while some required assistance and probing. This opportunity was not offered to the special education students.

The case of student A presented a typical example of teacher-student talk that occurred throughout the lessons. Order of operations was the topic of this particular lesson, and the objective of the lesson was to be able to solve the *x* value by following "BEDMAS" (order of operations proceeds as brackets first, followed by exponents, division, multiplication, addition, and finally subtraction). A balance beam scale with small weights was used as a concrete example for demonstrating the utmost importance of keeping the equation balanced at all times, simultaneously emphasizing that whatever is done to one side of the equation must be done to the other side. Always standing in close proximity to the balance beam scale, the teacher posed a question asking to investigate what would happen if a 10-gram weight was taken away from one side. Student A volunteered an answer to this question.

Student A stated that the beam would lean to one side because it was not balanced. In response to the teacher-directed question of what had to be taken away from the other side, the student again came up with the correct response, stating that 10 grams needed to be removed from the other side. Simultaneously pointing at the balance beam and the equation, and stating that 10 was going to be taken away from the left side so that *x* would be isolated, the teacher then asked what needed to be done to balance the operation. Confused at this point, the student did not answer the teacher-directed question, but instead asked if the teacher was referring to the *x* in the equation or the other part of the equation. The student admitted that he was confused, telling the teacher that he required further clarification and maybe re-teaching of the concept. Observations and transcribed notes from the sessions clearly confirmed that the student was confused and did not understand the concept.

The case of Student B presented data that was quite different in terms of teacher- student dialogue. After teacher B stated that a solution for the brackets had already been found, the teacher continued by asking if there were any other brackets in this same equation. Student B said “No”: which was the correct answer. Pointing the index finger to the expression “BEDMAS” on the chalkboard and then strategically stopping underneath the letter “E” in the expression, the teacher asked for the next step in the order of operations. Pausing with a puzzled look on his face, the student replied that there was a multiplication sign near the end of the equation.

During this particular conversation of instruction, teacher re-direction was correctly carried. The teacher stated that another question or step was required before proceeding to the multiplication part. Again pointing to BEDMAS, the teacher asked the student what was the next step after “B,” and to look at BEDMAS and at the equation. The student came up with the response “E,” which was the correct answer. Following this, the teacher asked the student to tell him what “E” stood for in terms of operations. Once again, the student gave the correct response, “exponents.” However, the limit of the student’s understanding was revealed when the student inquired if this operation meant multiplying by 2. At this point, it was evident that Student B had not consolidated the fact that the exponent 2 meant to expand the base number twice, and then multiply to get the answer for this part of the equation.

Results from this part of the data collection phase clearly indicated that special education students are not provided the opportunity to engage in mathematical discourse frequently enough to allow them to benefit academically. In fact, evidence from audio-recorded classroom sessions suggests that special education students achieve only partial understanding, and in most cases, no understanding of the concepts taught. This lack of engagement, interaction, and participation may well be a factor negatively impacting their understanding and achievement in mathematics. It seems that in most lessons, teachers are denying the formative evaluation process for these students. Evidence of this was clear in the transcriptions of teacher-student dialogues provided earlier in this section. Although these were two explicit examples, the same issue permeated lessons taught in the various mathematics strands at various grade and course levels.

Interviews. Interviews were conducted one-on-one with the campus principal and seven teachers (four female and three male teachers). The interviews were audio-recorded and then transcribed. Commonalities were coded. Data collected in this portion of the study revealed results common to the teachers as well as results that were unique for each individual. Both are valid results that merit analysis and discussion. There were a few areas of focus in the teacher questionnaire, namely the personal interests of teachers, their effect or impact on topics infused into mathematics lessons, and the effect of high participation of special education students in mathematics on student achievement.

The interview conducted with the principal was audio-recorded and later transcribed. A questionnaire was completed manually during the interview to probe for further clarification and elaboration on the answers provided (see Appendix A). Qualitative data were gathered to obtain and verify information on the demographics of the school and the ratio of regular students to special education students in each of the mathematics grade courses and level courses. During the interview, it was confirmed that there was a fairly even mix of male and female students. Due to location, the student population is very diverse. Exceptionalities reported in this urban high school were mostly learning disabilities (LDs) and mild intellectual disabilities (MIDs). Students were reported as each having their own individual academic strengths, weaknesses, and learning styles.

One of the principal's statements focused on the continual need to improve teaching and learning in the organization. Ongoing low levels of participation of special education students in mathematics are probably having some effect on these students' level of achievement. Appropriate levels of special education students' participation and engagement are not apparent during mathematics lessons. Questions are usually directed to the regular students in the class. There are a couple of reasons for this. First, as the principal discussed at length, the regular students usually volunteer answers, whereas the special education students rarely or never volunteer answers. Second, the teachers may have already formed preconceptions about the abilities of the special education students, and thus rarely or never call upon them to elicit responses to the questions, regardless of their levels of complexity.

Research Question 3

Research Question 3 asked, "How can teachers increase the level of engagement of special education students during mathematics lessons?" Audio-recordings and interviews were involved during the data collection phase to answer this question. The mathematics subject teachers offered rich information about how teacher interests influence topics infused in mathematics lessons. Other aspects that surfaced in this phase were some of the profile characteristics of the students in courses and some of the obstacles that might limit achievement for the special education students. All these data are summarized in tables in this section.

Audio-recordings. The observation sessions together with the audio-recording sessions allowed the opportunity to note a very important piece of data that lies at the center of this study. It was noted that the special education students who were allowed the opportunity to actively participate in and be engaged in the development part of the mathematics lessons often demonstrated only partial understanding of the concepts taught or confusion/no understanding. This was an ongoing issue throughout all lessons, regardless of the mathematics strand covered or the concept taught. A random sampling of observations was done in all the mathematics level courses, with a combination of both female and male teachers and students. Tables presented in Appendices E, F, and G summarize these data.

Interviews. In this concurrent nested approach, structured interview protocol was used in the qualitative portion. It focused on text analysis of transcribed interview data that was coded for themes. The process involved interviews with the campus principal and teachers, and the idea was to look for themes and concepts. Additional areas of focus were successful practices of teachers to increase the level of special education students' engagement in mathematics. Responses were coded according to this research question and were categorized as topic or concept is always, often, rarely, or never integrated. Data collected did, in fact, fit the codes, and in turn, the codes acted as a link between the research question and the interview transcript.

In this segment of the study, the principal interview revealed some interesting facts about the school. The teachers at this site have varied backgrounds and interests.

Although they are currently teaching mathematics courses, their academic backgrounds and interests include mathematics, biology, chemistry, special education, physical education, history, geography, law, general sciences, and social sciences. One aspect the principal emphasized was the difficulty of hiring only teachers for mathematics who had undergraduate majors or specializations in mathematics. Most of the teachers in the mathematics department have either a minor in mathematics, or have only completed some university courses in mathematics and are teaching in more than one department at the site.

The school principal reported that he rarely informally visited classrooms during mathematics lessons, so his knowledge is based mainly on the information gathered during teacher performance appraisal sessions. For the most part, the reason for this is lack of time during the school day. One aspect that was noted was the need for teachers to receive professional development training in mathematics and in assessments and evaluation, especially those who took only a few mathematics courses during their undergraduate studies and who are now teaching senior level mathematics courses. Although not all students receiving special education support in mathematics are on an individual education plan (I.E.P.), the principal clearly indicated that teachers are forced to teach to an average or norm and not to individual learning styles and the I.E.P. expectations. There is a need to differentiate according to learning styles. In class, a support model is in place so the special education students are integrated into the classroom during the mathematics courses. Concerns around students being disserviced was a reoccurring issue during the interview. An idea proposed by the principal was setting up a “Math Help” room by the mathematics department, with one or two teachers available at all times, where the students can drop in for help and assistance with their mathematics work.

Seven mathematics teachers were interviewed (four female and three male teachers). Anecdotes recorded on researcher logs indicated teachers were very cooperative and interested in the interviews and the study. Teachers' interests influencing topics infused in the development part of mathematics lessons were investigated and answers were categorized into four main groups—highly influenced, influenced, moderately influenced, or not influenced. All teachers willingly provided an answer to this question. Responses were quite clear in terms of the category chosen. The results are summarized in Table 4.

Table 4

Key Phrases Used in Teacher Interviews (N = 7)

Key Phrase	Number of Times Used
Topics highly influenced by personal interest	4
Topics influenced by personal interest	0
Topics moderately influenced by personal interest	1
Topics not influenced by personal interest	2

An interesting fact is that lessons delivered by female teachers tend to include topics related more to everyday living than those delivered by male teachers. These are subjects that students (especially at the essential, open, and locally developed levels) can relate to. Lessons delivered by male teachers had a tendency to incorporate themes and topics related more to sports, material sciences, and science and technology. An overlapping similarity in theme and concepts common to both male and female teachers was sports. However, themes and topics unique to female teachers were music, nutrition and food science, and travel and tourism. One aspect that certainly merits attention is that regardless of the gender of the teacher, the degree of influence lay at the extremes—topics were either highly influenced by personal interest, or were not influenced by personal interest. Only one teacher reported that the topics are moderately influenced by personal interest and none of the teachers reported that the topics are influenced by personal interest.

Four teachers stated that their interests highly influenced topics infused in the development part of the lesson, whereas one teacher stated that they moderately influenced it and two teachers reported they did not influence it at all. The ones who said their interests had no influence at all were both female. Other commonalities that stood out were issues of the students' focusing ability, the time factor in terms of curriculum coverage, and student achievement. Major factors reported as affecting student achievement were the inability to focus and the issue of distraction, especially among those students with Oppositional Defiance Disorder (ODD) and Attention Deficit Hyperactivity Disorder (ADHD) who were on medication. Attention Deficit Disorder (ADD) was not reported at all.

Other difficulties were the sustaining of attention necessary for these students to properly follow mathematics lessons. Even when these students were called upon to respond to teacher-directed questions, the questions had to be repeated and they still came up with incorrect answers. A plummet in their performance levels is an ongoing trend that in turn ultimately affects their student achievement. Field notes revealed distractibility as a contributing factor, in addition to their academic difficulties. This was observed consistently throughout the data collection sessions.

Table 5

Teacher Interests Influencing Topics Infused in Mathematics Lessons

Teacher	Male/Female	Highly Influenced	Influenced	Moderately Influenced	Not Influenced
A	Female				X
B	Female			X	
C	Male	X			
D	Female	X			
E	Male	X			
F	Male	X			
G	Female				X

Another factor reported was the large number of expectations required to cover in each of the strands for reporting purposes. Special education students experience difficulties with crucial steps required in learning mathematics, namely reading, processing, and problem-solving. One answer common among all teachers was that the more the questions were scaffolded, the better the students seem to do on them, the special education students included. However, the amount of time to deliver the curriculum and teach the expectations is limited, especially when there are students in the class working at various grade levels in all the strands. Teachers reported that these students are occasionally asked questions that require multi-steps in the process to arrive at the final answer. Therefore, they are not being allowed, even with teacher assistance, to break down the questions, isolate the given information, come up with a plan, and work through the steps. One teacher strongly emphasized the issue of social justice for these students.

Table 6

Common Factors Reported as Affecting Student Achievement

Teacher	Inability to Focus /Distraction Factor	Time Factor for Curriculum Coverage	Medical Diagnosis - ODD	Medical Diagnosis - ADHD
A	X		X	
B	X			X
C		X	X	
D	X		X	
E		X		X
F	X			
G	X	X		X

Table 7

Commonalities in Teacher Interviews Responses

Key Phrase	Number of Times Reported
Special education students' inability to focus	5
Special education students possessing poor skills	5
Special education students' inability to follow lessons	4
Concerns about poor student achievement	7
Time restraints due to volume of curriculum	3
Special education students performing better due to scaffolding	6
Social justice issue in terms of deserving services	1

In summary, although great efforts are being made by the principal and the teachers to provide opportunities for special education students to be actively engaged in mathematics lesson sessions, obstacles still exist that seem to act as barriers. Common factors stated in the interviews were the teachers' personal and background knowledge and the pressing urgency to cover the curriculum. Time restraint was another ongoing issue, resulting in special education students not being given the time necessary for participation and engagement or for scaffolding. This may well be a contributing factor to underachievement in numeracy for this student populace. Other obstacles reported were lack of technology and programs in the classroom to support student learning, the need for teachers to receive professional development in teaching and learning mathematics, and student profiles that led to inability to focus.

The results and findings of the study were presented in this section. It contained both qualitative and quantitative data to answer the three research questions. Sources of data collection included observations of mathematics lessons and teacher-student interactions, audio-recordings of these lessons, and interviews. Section 5 offers in-depth data analysis, discussion, and interpretation, leading to conclusions, summary, and recommendations.

Section 5: Discussion, Conclusions, and Recommendations

This study was conducted to improve the teaching and learning of mathematics for the special education student populace. Special education students experience a significant drop in mathematics achievement from one year to the next, and the achievement gap keeps increasing. Student achievement and academic progress for this student populace is minimal from year to year across all grade levels. Equal opportunity and fairness in the level of participation of special education and regular students in mathematics lessons are issues of both equity and opportunity for improving student achievement. Fairness implies that special education students must be called upon to respond to teacher-directed questions a proportionate number of times compared to regular students. The aim of this study was to determine whether instructional strategies and techniques in the classroom are additional factors contributing to the drop in numeracy achievement. These results warranted further investigation.

The goals of this study were twofold. Improvement of educational practice and reform of teaching and learning in the area of mathematics education for the special education student populace was the first goal. Investigation into necessary social change to improve student achievement in mathematics for special education students was the second. A mixed method approach was required, given the fact that the study contained both a quantitative and qualitative component. This was an exploratory study on current practices in the study setting.

The mixed methods study used a concurrent nested strategy to determine whether equal opportunities are provided to mathematics special education students to learn and improve during the development part of mathematics lessons. For the qualitative portion of the study, the focus was text analysis of transcribed interview data and coding for themes. In the quantitative portion of the study, the focus was descriptive statistics, including number of teacher/student interactions for each group and percentages. A pre-experimental design was used for this part of the study. Data from the two portions were merged in section 4. Thorough analysis of the data allowed for solid interpretation of the findings, in turn leading to conclusions and recommendations.

The key issues investigated were the level of participation of special and regular education students during mathematics lessons, the impact of increased student participation and engagement in mathematics lessons on special education students, and the ways in which teachers can increase the level of special education students' engagement during mathematics lessons. In this research, the qualitative study was a subset of the quantitative study. For the quantitative portion of the study, a structured observation protocol was used. Mathematics classes were observed to gather interactions between teachers and students, and the observations were coded according to student group membership. A structured interview protocol was used in the qualitative portion of the study, in which seven campus teachers and the campus principal were interviewed. All interviews were conducted separately, one on one. Audio recordings were transcribed and used in the analysis.

The qualitative portion of the study employed two separate instruments—an administrator interview and a teacher interview. These interviews were related to the research questions. Specific instruments such as the principal and teacher interview questions were designed to gather qualitative data on the demographics of the school and the personal interests of the teachers. Other instruments focused on effects of the high degree of engagement and participation levels in mathematics of the special education students and on teacher best practices to increase the level of special education students' engagement in mathematics. Probing for clarification of answers provided by the respondents led to further analysis and insights into teacher questioning styles and techniques.

The first research question investigated the degree of participation of special education and regular students during mathematics lessons. Its purpose was to examine the frequencies and percentages of classroom interactions during mathematics lessons in terms of eliciting responses to teacher-directed questions. The second question determined the impact of increased student participation and engagement in mathematics lessons on special education students. Through interview narratives, this question's purpose was to investigate how high participation of special education students in mathematics affects the students. Determining ways in which teachers can increase the level of engagement of special education students during mathematics lessons was the aim for Research Question 3.

Summary of Findings

Findings revealed that, although great efforts are made by the principal and the teachers to provide opportunities for the special education students to be actively engaged in mathematics lesson sessions, obstacles still exist. The factors or obstacles may act as barriers, leading to a negative impact on student achievement and social change for them. Common factors that surfaced during the interviews were teachers' personal and background knowledge and the pressing urgency to cover the curriculum. Time constraints were also reported as a common ongoing issue, depriving special education students of the time required for scaffolding. Underachievement in numeracy for this student populace may be rooted in this practice. Other obstacles randomly reported were lack of technology and programs in the classroom to support student learning in numeracy and the need for teachers to receive professional development in teaching and learning mathematics. Students' academic abilities and behavioral profiles contributing to inability to focus were underlying factors commonly reported throughout the study.

The results I have obtained from this study indicated that the majority of teachers exercise best practices in terms of curriculum delivery in mathematics. However, fairness in actively engaging the special education students in the lessons is still an issue that urgently needs to be addressed. Regardless of the mathematics grade or course levels, special education students are being deprived of their deserved level of engagement. Evidence of this was clear in the data presented in Section 4. Furthermore, the calculated frequency and percentage values reveal a definite difference in their levels of participation. This is concrete proof of social injustice toward them.

Special education students are not currently being given the required and deserved opportunity to engage in mathematical discourse frequently enough to benefit them academically. Evidence from audio-recorded classroom sessions from this study revealed that special education students achieve only partial understanding, and in most cases, no understanding of the concepts taught. The low degree or lack of engagement, interaction, and participation may be possible factors negatively impacting their understanding of numeracy concepts and skills and, in turn, student achievement in mathematics. Current teacher practice is denying the formative evaluation process they rightly deserve, and this issue was prevalent in most lessons taught in the various mathematics strands at the various grade and course levels. Students with learning exceptionalities are not being called upon enough to respond to teacher-directed questions. Frequency and percentage values calculated confirm this type of injustice. Examples of teacher-student dialogue from classroom transcriptions provided concrete proof and evidence of this injustice.

Interpretation of Findings

The analysis of the data revealed that special education students in mathematics are currently not being called upon proportionately, compared to the regular education students, to respond to teacher-directed questions. In fact, their regular education classmates were called upon almost twice as often. Such disengagement leads to passivity, distraction, and loss of opportunities to articulate their answers. Consequently, they rarely reveal their thinking processes and logic. Formative evaluation is not occurring for them through student-teacher dialogue.

Teachers are not allowing special education students the classroom discourse that may reveal the limits of their understanding of concepts and skills. This may be impacting their numeracy achievement and contributing to the widening of their achievement gap. Like the regular students, they deserve opportunities to be actively engaged in teacher-student talk. Increasing the level of engagement of these students during mathematics lessons is an issue that educators at all levels need to address and for the sake of best practices. Professional development geared toward instructional techniques in this respect would certainly benefit most teachers. Although teachers do call upon special education students to elicit responses to teacher-directed questions, the necessary frequency of this practice is still lacking. Further study and investigation of this issue on a larger scale is strongly recommended.

According to Shulman's (1987) model of pedagogical reasoning, although there is only partial understanding of subject matter, these opportunities continue to allow teachers to determine exactly where the students' level of understanding break down and the kind of teaching intervention required for them to reach the next level of understanding. Evidence of this was revealed in the transcript of a specific audio-recorded lesson on solving equations. The teacher demonstrated two examples and then used a third example to evoke teacher-student dialogue in an attempt to work through the steps to answer the question. Emphasis was placed on doing the same thing to one side of the equation as was done to the other side to eventually isolate the unknown and solve for it. A balance-beam scale with small weights was used, emphasizing the concept that doing the same thing to both sides of the equation keeps the balance-beam scale, as well as the equation, balanced. However, even after the thorough explanation and demonstration during the development part of the lesson, students still experienced difficulties with the question, resulting only in partial understanding of the mathematical topic and concept.

Constructivists hold that knowledge is constructed by the learner through interaction with the learning environment—this is the constructivist learning experience. How students construct knowledge is not known. The only way to follow their reasoning is by allowing them to articulate it and by the teachers trying to follow their arguments. With teacher assistance, some students may be able to come up with part of an answer. Articulation of the student's process used in answering questions and solving problems, along with appropriate probing techniques by the teacher, may reveal the limits of the student's understanding of the concepts. Best practices hold that the teacher should pull aside the students who have only partial or no understanding as a small group and conduct mini-lessons to review and reinforce the concepts and skills taught. Classroom practice of this nature represents social justice toward this student populace.

This study was grounded in Kamii's (1987) theory of constructivism, Vygotsky's (1978) notion of the ZPD, and Schon's (1983) reform of teaching and learning with problem-setting as a recognized professional activity. Although it did not address methods to engage students, a recently conducted study concluded that all students must have access to high quality, engaging mathematics instruction (citations needed here). Student A, for example, experienced some difficulty in providing the correct answer to the teacher-directed question. With teacher assistance, the student was able to provide part of the response. According to the notion of the ZPD (Vygotsky, 1978), this was still teacher-assisted performance. The student's response indicated that the student had not yet proceeded to a level of independent performance in this area.

The preceding case clearly indicated that the student was still working at a level of teacher-assisted performance. Scaffolding is defined as the precise help that enables a learner to achieve this specific goal that would not be otherwise possible without some kind of support (Sharpe, 2006). Vygotsky's (1978) ZPD is the distance between a student's actual development level and the level of potential development as determined through problem-solving with guidance and collaboration (Cole, 2006). This example illustrated how this special education student in mathematics benefitted from being called upon to answer a teacher-directed question and allowed to articulate his reasoning. Best practices such as this need to be exercised on a consistent basis during all mathematics lessons.

On another occasion, Student B was unable to articulate the steps used in solving equations using order of operations. Order of operations involving BEDMAS (brackets, exponents, division, multiplication, addition, subtraction) was used for the process. Teacher probing and clarification were required to facilitate comprehension of the subject matter. Through this type of interaction, Student B was allowed to reflect and revise his thinking and consolidate the concepts taught. Work in mathematics involving articulation of the process, visualization, reasoning, and communication causes changes in students' thinking.

Confusion or no understanding occurred while Student B was using the BEDMAS process. Difficulty was experienced in understanding concepts and questions posed and subsequently coming up with the process or steps required to arrive at the final answer. Teachers do not know what is going on inside the students' minds. Only by articulating the thinking process and the answer was Student B able to reveal the difficulty in understanding the question and coming up with the answer. This exemplified a case of special education students in mathematics who need to be called upon to articulate their reasoning and reveal their thinking process. Even after teacher probing, confusion still persisted, confirming that there had been no transformation of the teacher's comprehension of subject matter into the student's comprehension of subject matter (Shulman, 1987).

According to Shulman's (1987) model of pedagogical reasoning, there has been minimal, if any, transformation of the teacher's comprehension into the student's comprehension. Because the student had not built logico-mathematical knowledge, re-teaching was essential to transform teacher comprehension to student comprehension of the subject matter. Teacher-student interactions during mathematics lessons benefit both the students and the teachers in relationship to opportunities to improve learning and student achievement and performance of formative evaluations of the students on the subject matter taught. Students confirm this aspect through articulation and expression of their understanding of the concepts. This study suggests possible links between lack of student engagement and participation in mathematics lessons and the underachievement of the special education students.

The results of this study revealed a significant difference in the level of participation of special education and regular students during mathematics lessons. Special education students are participating only 62% of the time and are being denied 38% of their deserved opportunities. This is more than one-third of their opportunities during each mathematics lesson. Regular education students get called upon more frequently, thus denying special education students of the formative evaluation process. According to the transcripts of mathematics lessons, most of the level 1 and 2 questions are still being directed to the regular students.

The outcomes in section 4 demonstrated that the lack of special education student engagement and participation in mathematics lessons is a potential contributing factor that negatively affects their numeracy achievement levels. This conclusion is supported by data gathered from interviews, observations sessions, and transcriptions of classroom session audio-recordings from the qualitative and quantitative portions of the study. Raw data tables, charts, and graphs in section 4 summarize the results. Evidence of quality was assured through member checks and triangulation of data. All the members who participated in the study were current practitioners in the field of education. Triangulation of data was done through different data sources, including interviews, audio-recording, and observations. Therefore, the data appear to be substantial and credible.

The slow rate of special education students' achievement in mathematics is attributed to each individual student's exceptionality. However, the results of this study revealed that instructional techniques such as lack of regular participation and active engagement in mathematics lessons seem to be added factors. Data collected from the interviews, classroom sessions audio-recordings, and classroom observations support this conclusion. This is bounded by the evidence collected using the instruments described.

The theoretical foundation for this study lies within constructivist learning. Constructivism is based on the process by which children create and develop their ideas or knowledge (Lunenberg and Ornstein, 2004). How students construct knowledge is not known. During lessons, therefore, students should be routinely asked to discuss and clarify their own thinking about mathematical ideas and to make convincing arguments. Teachers' awareness of these issues and learning of pedagogy is empirical (Caldwell, 1995). Ball et al. (2005) suggested that teacher learning must include additional mathematics content classes, extended mathematics institutes, lesson study, and collaboration with peers. Ultimately, the aims are to improve learning and to increase student achievement.

Through active participation, the students will reveal their thinking process and understanding of the subject matter. Therefore, no child should suffer in terms of academic instruction and teacher attention to the benefit of other students. Ongoing teacher-student talk during the development of a lesson will allow aspects such as these to surface. One aspect is the limit of student understanding of the subject matter. These, in turn, need to be addressed by the respective teachers.

Because education is a fundamental right, those who provide it must ensure that each student obtains it to the best of his or potential and ability (Alexander & Alexander, 2005). All children are able to learn and, therefore, need to be actively engaged in lessons. The content, process, product, and learning environment must be shaped to enhance success of all students. Murphy (2005) stated that both principal and teacher leadership significantly influence important features in the school, one being instructional techniques. Teachers must provide these students with different approaches and opportunities to enhance their learning, and principals need to ensure that proper instructional techniques are in place in every mathematics class or course. They must be responsive to a wide range of readiness levels, varying interests, and learning profiles (Tomlinson, 2005).

According to Kamii (1987), how students construct knowledge is not known. Students need to articulate the process. Allowing them to reveal their reasoning gives teachers the opportunity to follow their arguments and reasoning. The examples of Students A and B illustrate this point. Revealing their thinking process and explaining how they arrived at the answers is integral to both the formative and summative evaluation process for the students. It allows the teacher to determine the limits of the students' understanding of concepts and serves as a springboard for logical re-programming.

Constructivism is based on the process by which children create and develop their ideas or knowledge (Lunenberg & Ornstein, 2004). This is where the gap exists. The results of this study indicated that the opportunity for the students to create mathematical knowledge was given mainly to the regular students during mathematics classes. However, like the special education student populace in this study, many students in our education systems are alternative learners. They are referred to as "special education students," and in most cases, they are integrated into the regular classroom for courses appropriate for them in terms of level of difficulty. Therefore, the provision of services to meet their needs is not only a professional duty, but also a responsibility, and the absence or lack of it is, indeed, social injustice.

According to the notion of the ZPD (Vygotsky, 1978), in cases in which there was still teacher-assisted performance as in the cases of both Students A and B, the students' responses indicated that they had not yet proceeded to a level of independent performance. Both these examples clearly demonstrate the urgent need for students to be asked routinely to clarify their own thinking about mathematical ideas (Caldwell, 1995). Special education students are no exception to this, for they also need the opportunity to articulate responses. Conversation and reflective thought as instruction time ended needs to be reinforced (Sibley, 2007). Articulation of the process used reveals the student thinking process.

In this study I have gathered data and results that will benefit education practitioners in many roles. The information may be useful to school administrators for classroom instructional techniques, in-service planning and co-ordination, and facilitating debriefing sessions about teacher performance appraisals. Providing an awareness of this issue and generating suggestions and advice to improve teaching and learning were goals of this study. If schools are to become agents and promoters of positive social change by going beyond current practices, then best practices need to permeate every lesson, regardless of the subject presented and the level of courses. Given the fact that policy and practice inform each other, repeating this study on a larger scale and in the larger arena of education may provide data and sufficient evidence conducive to revisiting special education policies and procedures implemented by school boards. Evidence from these results would be of particular interest to leaders such as principals who aspire to positive social change and to lead their organizations toward excellence. In addition, it would provide university researchers with awareness on instructional technique deficiencies in classrooms in educational institutions.

Regardless of their mathematics grades or academic levels, learners need to be engaged in their learning. The importance of active participation and engagement cannot be stressed enough. Equally important are opportunities to articulate their reasoning, thus revealing their thinking process and limitations in understanding the subject matter. Acquiring an awareness of this deficiency gives the teachers the opportunity to evaluate their own practices. Best practices need to be exercised by all teachers toward all students; denial of this practice and opportunity represents social injustice, as evidenced by the results of this study. Classroom observation, audio-recordings, and transcripts clearly revealed that special education students were denied engagement opportunities in the level 1 and 2 questions in the observed mathematics lessons. This represents evidence of professional incompetence on behalf of the teachers and social injustice toward the special education students.

In terms of communities of practice, results from the study suggest that school principals need to establish better communication networks for faculty suggestions and feedback about budget allocation and needs for professional development. It is urgent that staff members attend staff professional development in mathematics education and special education and for school boards to promote and facilitate this continuing education. Professional development would expose teachers to new concepts, teaching strategies, and methodologies. Workshops focusing on instructional techniques for classes containing students with diverse learning styles and needs are greatly needed. The intervention recommended is professional development plans that will sustain an effective learning community of practice within each learning organization.

It is not only an institutional responsibility, but also a school expectation that schools work with every student, including the special education students, to create a better-educated and prepared generation for future society. Our educational institutions are currently not providing a positive future for all students to the extent that they are able. Therefore, social justice is necessary. This study provided initial evidence suggesting a need for improvement of educational practice in our school systems to boost achievement for all special education students regardless of their background, interests, and abilities as well as positive social change for them. The possible impact of increased participation and engagement of special education students in mathematics lessons has been identified through this study. It has also generated awareness of the benefits of keeping these students more focused, possibly leading to improved achievement in the area of numeracy, which in turn equips them with the concepts and skills needed to function in society.

Implications for Social Change

As stated in the significance section of section 1, inclusion has led school systems to change. Students with different academic capabilities and varied profiles and exceptionalities are now integrated into our school systems. This includes students at different academic levels of achievement and varied abilities in mathematics. Many students in mathematics within our modern educational organizations are alternative learners. They are not receiving the services they need to learn numeracy concepts and acquire the numeracy skills they urgently need to function and operate within society.

The outcomes presented in section 4 reveal that the special education students are participating only 62% of the time in mathematics lessons. They are being denied 38% of the opportunities of participation and engagement. Disengagement of this nature at times leads to passivity and distraction, in turn leading to lower levels of achievement. Therefore, changes are urgently needed in terms of methods of delivering mathematics lessons to increase their level of engagement. Improvement in teaching techniques and practices is a definite urgent need, one that school administrators must make a point of evaluating during teacher performance appraisal sessions. This implies tangible improvements at every level—the classroom, the school, the board, and the ministry.

If schools are to be promoters and agents of positive social change, then best practices must be exercised to educate our students and improve student achievement in numeracy for every student, special education students included. Positive social change is required in this area. The changes need to be addressed and mandated by government policy, all for the improvement and betterment of society. Changes need to permeate all levels of our educational institutions—the boards, the schools, and the classrooms. It is the responsibility of individuals in leadership roles to ensure that communities of practice are formed and that each member within those communities is working toward achieving a common goal—the improvement of achievement in numeracy for all students, including the special education student populace.

Recommendations for Action

The conclusions of this study are conducive to suggested critical steps and actions necessary for the advancement of educational practice for improving achievement of special education students. Just as important as summative evaluation is formative evaluation, which occurs during every lesson. In turn, teachers' reflections on lessons delivered and reprogramming for subsequent lessons based on the amount of learning that has occurred needs to be present during every lesson to maintain the continuum and integrity of teaching and learning. While these will always serve the purpose of identifying levels of student performance, their major purpose is to teach all students, regardless of their academic levels and abilities, and to contribute to student academic growth. This core belief must be alive in every classroom if our educational systems are to meet the goals for all students and allow them to achieve success and to close the achievement gap. Although special education students do not have potential equal to that of regular students, they should still have the same opportunity to achieve to their fullest potential academically, because every child has the ability to learn.

A number of parties need to pay attention to and consider the results of this study. At the classroom level, teachers need to reflect upon their own practices in terms of instructional techniques and delivery of mathematics lessons. Student engagement must be ensured in every mathematics lesson, so that formative evaluation can be performed on all students in the class, regardless of their academic abilities and levels. Annual growth plans submitted school administration should include this goal from all teachers lacking in this area. Teachers with mathematics as their current teaching assignments may want to consider attending professional development sessions for in-service programs in this area.

It is important for administrators to pay attention to the results of this study to benefit their communities of practice. The results would benefit school principals in regard to teacher performance appraisal sessions and school improvement plans. In addition, supervisory officers or superintendents of education may find the information useful in terms of principal evaluations and discussion and evaluation of school improvement plans for schools as communities of practice. Ministry of education officers may want to consider the results of the study for policy-making and re-visitation in regard to special education. Professors or researchers at the university level may want to conduct a study similar to this one on a larger scale to confirm the results and further validate them. Closer examination is definitely recommended, possibly encompassing a new round of questions. Conducting such a study may contribute to the body of knowledge and affect the model by which the special education student populace in our schools is serviced.

The results and information from this study may be disseminated in a number of ways. One would be through publication in educational journals. Another is to provide permission to colleges and schools of education to include copies of the study and results in their libraries. A third method of dissemination is through university and college e-library systems. These options would be conditional upon the recommendation and approval of authorized parties involved.

Recommendations for Further Study

Application of this study on a larger scale requires further study. The benefit of confirming the data in the larger educational arena would add credibility and substantiality. Another option would be an investigation of ways in which the findings of the study could reform teaching and learning in this area, such as integration, mainstreaming, policy-making, and so on. There is an urgent need to further explore these concerns for possible educational reforms for the benefit of mathematics special education students in our school systems. All these are possible springboards to further study and potential research projects.

Other topics that might create a whole new set of questions are the effectiveness of integration for the special education students in terms of their student achievement, the investigation of the outcomes and benefits of mainstreaming, partial integration as opposed to full integration of special education students in the regular classroom, and so on. Partial integration would mean students would be placed in separate small classes with other students who are functioning at their own level in numeracy, and integrated into classes with other age-appropriate placed students for the other subject areas, such as physical and health education, science, social studies or history and geography, visual arts, drama, and music. Questions for further study would revolve around the idea of the attention devoted to the special education students by the teacher during mathematics and opportunities they would receive in terms of direct engagement and involvement in mathematics lessons. This, of course, would affect student placement, teacher assignments and teaching partners, school organization, scheduling, timetabling, and so on at the school level. At the board and ministry levels, this would imply re-visitation and changes in policies and regulations. An additional possibility would be to hire mathematics specialist teachers to teach mathematics only in the elementary panel on rotating schedules. The aim and ultimate goal is for the improvement and increased achievement in numeracy for special education students.

Reflection

The completion of the study led to reflection on several main aspects. First is the aspect of the potential improvement of student achievement when special education students are engaged on a more regular basis, sustaining their focus and attention. Second is the application of the study to the larger arena, which would imply suggestions for further study. Third is the way in which the findings would reform teaching and learning in this area (Schon, 1983). These aspects have all been outlined and discussed in earlier parts of this section. Ultimately, the goals are to promote positive social change and social justice, to improve student achievement in mathematics for these youngsters so that they may function better in society, and to advance the betterment of society at large.

In the qualitative portion of the study, interviews and classroom observations were conducted with no personal biases or preconceived ideas and values. An open-minded approach was adopted and only what was observed or heard during the sessions was recorded. There seemed to be no possible negative effects of the research on the participants. Data were collected from a non-regular member of this school site as a community of practice. The same applied for the quantitative portion of the study. All the data collected was strictly from observations and transcripts of mathematics lesson sessions. Results from both portions of the study were conducive to change in thinking about the light shed on this issue as well as the experience gained from the research experience itself.

Concluding Statement

This study has contributed to the body of knowledge in terms of factors influencing levels of participation of special education and regular students during mathematics lessons, the impact of increased student participation and engagement in mathematics lessons on special education students, and the ways in which teachers can increase the level of engagement of special education students during lessons in this subject area. In addition, the study has provided some initial data and information that may serve to inform educational policy, practice, and reform. Educators must ensure that programs are in place by fully qualified teachers and other professionals. Lending itself to great importance due to generation of knowledge, the study led to suggestions for professional application and implications for positive social justice. Aiming for positive social change as its ultimate goal, the study identified the impact of special education student participation and engagement in mathematics lessons.

The study has identified more effective instructional techniques that teachers can adopt in the classroom to increase the level of special education students' engagement in mathematics lessons. Our educational institutions need to provide the brightest future for all students in our school systems, including special education students, to the extent that they are able. Essential elements required to achieve this are social justice and positive social change that will allow them to improve student achievement in the area of numeracy. The aim is the betterment of this particular group within our society. Best practices must be exercised by all educators, at every level, to bring about positive social change in this respect.

This research has informed the field of education, added to the body of knowledge, and informed policy of necessary changes to special education teaching, guidelines, and policy. The information gathered from this study has informed social change by providing awareness of an urgent need for improving educational practice in the day-to-day teaching environment. Some areas that require re-visitation, changes, and improvements have been clearly identified in this study. Given the fact that reform to promote the development of individuals and learning communities often occurs due to actions taken by administrators and other school leaders in response to a particular problem, leaders must possess strong leadership skills that represent a shift from being an administrative leader to being a leader in the education profession. Creating a community of practice is the first step toward achieving this goal.

It appears that active participation and engagement of special education students in mathematics lessons does impact their achievement in numeracy. Suggestions for improvement on a system-wide scale have been provided by the results of this study. Recommendations focused mainly on positive social change and social justice for the special education student populace. The intentions and goals are the improvement of educational services for them in the hope of preparing them better to function in society. Like regular students, acquiring numeracy concepts and skills is empirical for the special education students. Our educational institutions still have the responsibility of ensuring proper services and adequate opportunities for participation and engagement for them. Access to education and to a better style of life is a human right.

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Appendix A: Campus Principal Questionnaire

Thank you for participating in this study and for your time to answer this important questionnaire. The questionnaire will help gather some important information regarding this community of practice. It is an integral part of the study.

What is your personal academic background?

What are your experiences as a teacher in terms of your teaching assignments?

What are your experiences as a school principal/administrator?

What is the cultural make-up of the student body at your school?

What are the areas of strength in your organization in regard to the staff and the student body?

What are the areas of need in your organization in regard to the staff and the student body?

What is the ratio of special education students to regular students in your school?

For the next set of questions, please choose the one most appropriate response.

Which placement model would best service these students?

a. in-class support model
b. withdrawal support model
c. combination of both depending on the topics, concepts and skills being taught

What is model in place at your school in terms of service for special education students?

a. in-class support model
b. withdrawal support model

How often do you visit the classes informally during mathematics lessons?

a. almost always
b. often
c. rarely
d. never

How would you describe the level of participation of special education students and regular students during mathematics lessons?

Are classroom teachers directing lower level thinking questions to this group of students in order to keep them actively engaged?

a. yes
b. no
c. not sure

Are all students receiving special education support in mathematics on an Individual Education Plan (I.E.P.)?

a. yes
b. no
c. not sure

Are special education students actively engaged in mathematics lessons during the development part of the lesson?

a. yes
b. somewhat
c. no

Are appropriate accommodations and modifications provided for these students during mathematics lessons?

a. yes
b. no
c. not sure

Do these students have access on a consistent basis to computers and programs to help enhance mathematics concepts and skills taught?

a. yes
b. no
c. not sure

Are appropriate and sufficient manipulatives available in the classroom for these students to use?

a. yes
b. no
c. not sure

Do teachers deliver mini-lessons to these students in small group settings based on formative evaluations during mathematics lessons?

a. yes
b. no
c. not sure

Do teachers spend proportionately equal amounts of time with special education students compared to regular students during the extension parts of mathematics lessons?

a. yes
b. no
c. not sure

What would you like to see in mathematics lessons that would increase special education student participation and engagement in these lessons?

How can teachers change or modify their mathematics lessons to allow for an increase in level of engagement of special education students in these lessons?

Thank you for your participation in this interview. All your answers will be kept confidential.

Appendix B: Classroom Teacher Interview

Name: ____
Date: ____
Time: ____

Thank you for participating in this interview. An important objective of this study is to examine the impact of special education student participation and engagement in mathematics lessons and what teachers can do to increase the level of these. Your honest responses are much appreciated. You will not be identified in any way.

What are your areas of interest?

What is your personal background?

Does your personal background influence the subject matter taught in the classroom?

Are the special education students in your class during your regular mathematics lessons?

a. yes
b. no

(If yes) How often do they volunteer answers to teacher-directed questions?

What percentage of the questions do they actually get to answer, or comment on, or expand on?

(If yes) Are the special education students focused on lessons and participating in lessons?

Is this affecting student achievement?

As a teacher, how would you change or modify your mathematics lessons to allow for increased participation and engagement of special education students?

Thank you for your participation in this interview. All answers will be kept confidential.

Interviewer Reflective Notes:

Observations – Interviewee Behavior During the Interview:

Appendix C: Transcript of Mathematics Lesson

Date: ____Time: ___________________

Grade Level Observed:___________________________ Course Level: ____________

Mathematics Lesson Topic: _______________________ Audio-cassette Number____

Transcript

The following is a transcript of the mathematics lesson as transcribed from this classroom audio-recording session.

Appendix D: Teacher Student Interactions during Mathematics Lessons

Mathematics Lesson: Topic:

Mathematics Strand:

Term:

Grade: Course Level:

School Name:

Teacher First Name and Last Name Initial:

School Grade	Number of Regular Students (R)	Tally of Number of Times Called Upon (R)	Number of Special Education Students (S)	Tally of Number of Times Called Upon (S)
	Total:			Total:

Appendix E: Teacher Student Interactions during the First Mathematics Lesson Sessions per Course

Course Code	ts	rm	sem	tpm	perm	pesem
IA	26	22	4	8	7	1
IB	24	21	3	9	8	1
IC	27	23	4	5	5	0
ID	29	25	4	9	9	1
IIA	30	26	4	11	10	1
IIB	25	21	4	4	4	0
IIC	24	22	2	8	8	1
IID	28	25	3	6	5	1
IIIA	26	23	3	9	8	1
IIIB	26	22	4	6	5	1
IIIC	28	24	4	8	7	1
IIID	24	21	3	7	6	1
IVA	24	20	4	5	5	0
IVB	27	24	3	7	7	1
IVC	30	25	5	11	10	2
IVD	26	22	4	8	7	1

Appendix F: Teacher-Student Interaction during the Second Mathematics Lesson

Sessions per Course

Course Code	ts	rm	sem	tpm	perm	pesem
IA	26	22	4	8	7	1
IB	24	21	3	9	8	1
IC	27	23	4	5	5	0
ID	29	25	4	9	8	0
IIA	30	26	4	12	10	2
IIB	29	25	4	4	4	0
IIC	24	22	2	8	7	0
IID	28	25	3	5	5	0
IIIA	26	23	3	8	8	0
IIIB	26	22	4	5	4	1
IIIC	28	24	4	8	7	1
IIID	24	21	3	6	6	0
IVA	24	20	4	6	6	0
IVB	27	24	3	3	3	0
IVC	30	25	5	11	9	1
IVD	26	22	4	8	7	1

Appendix G: Total Teacher-Student Interactions per Course during the Two Mathematics Lesson Sessions

Course Code	ts	rm	sem	tpm	perm	pesem	prm	psem	pprm	ppsem
IA	26	22	4	16	14	2	84.6	15.4	87.5	12.5
IB	24	21	3	18	16	2	85.5	12.5	88.9	11.1
IC	27	23	4	10	10	0	85.2	14.8	100.0	0
ID	29	25	4	18	17	1	86.2	13.8	94.4	5.6
IIA	30	26	4	23	20	3	86.7	13.3	87.0	13.0
IIB	25	21	4	8	8	0	84.0	16.0	100.0	0
IIC	24	22	2	16	15	1	91.7	8.3	93.8	6.2
IID	28	25	3	11	10	1	89.3	10.7	90.9	9.1
IIIA	26	23	3	17	16	1	88.5	11.5	94.1	5.9
IIIB	26	22	4	11	9	2	84.6	15.4	81.8	18.2
IIIC	28	24	4	16	14	2	85.7	14.3	87.5	12.5
IIID	24	21	3	13	12	1	87.5	12.5	92.3	7.7
IVA	24	20	4	11	11	0	83.3	16.7	100.0	0
IVB	27	24	3	14	13	1	88.9	11.1	92.9	7.1
IVC	30	25	5	22	19	3	83.3	16.7	86.4	15.0
IVD	26	22	4	16	14	2	84.6	15.4	87.5	12.5

Curriculum Vitae

Mr. Ferrara was born in Manoppello, P. Pescara, Italy on July 7, 1957. He came to Canada at the age of 2 and has resided here since. Mr. Ferrara graduated from the Toronto District School Board in 1977. He attended the University of Toronto, where he received a B.S. in biology in 1982. A few years later, he continued his education and received a B.Ed. degree in elementary education from the University of Western Ontario in 1987. Mr. Ferrara attended York University on a part-time basis and received a B.Ed. (Inservice) degree in middle school teaching, religious education, and special education. He graduated from this program in 1991.

In 1997, Mr. Ferrara obtained a M.Ed. in mathematics education from the University of Western Ontario (London, Ontario, Canada). During this time, he was employed with the York Catholic District School Board. His teaching experience includes regular classroom and special education assignments. As a special education teacher, he taught students at all grade levels in the elementary panel. He successfully completed a certificate program in crisis prevention and intervention (CPI) that helped him better understand and service young students with behavioral and emotional needs.

Recently, Mr. Ferrara has been an instructor on a part-time basis for York University, Faculty of Education, Professional Development Programs. During this time, Mr. Ferrara has lectured and taught courses in special education for certified teachers. The courses focus on assessments and programming for students with special academic and behavioral needs. Still employed by the same district school board, Mr. Ferrara has taught in the same elementary school for the last nine years. This has allowed him to know his students and learn about the school culture, and at the same time focus on his doctoral level studies. He is currently completing his Ed.D. in administrator leadership for teaching and learning at Walden University (Minneapolis, Minnesota, U.S.A.).