INSTRUCTIONAL EVENTS AND STRATEGIES WITHIN EIGHTH GRADE SINGLE-SEX AND COEDUCATIONAL MATH CLASSROOMS

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CHAPTER I

INTRODUCTION

Are single-sex classrooms benefiting males and females or simply reinforcing stereotypes? This controversial question is fueled by political and social implications. In a CNN video broadcast of December 10, 2009, this question and two opposing views were presented. The proponent, Dr. Leonard Sax founder of the National Association for Single Sex Public Education and author of *Why Gender Matters* stated,

> The surprising finding is that the coed classroom ends up disadvantaging both girls and boys, ends up reinforcing gender stereotypes. The girls end up thinking that abstract number three is for boys, and the boys thinking creative writing is for girls (CNN Student News, 2009).

The opponent, David Sadker author of *Failing at Fairness* stated,

> If you assume that boys behave one way and you teach to that stereotype and you assume that girls learn another way and you teach to that stereotype, what you're doing is limiting the option of kids. You're reinforcing stereotypes (CNN Student News, 2009).

So, the debate continues regarding the place of single-sex classrooms in America's public schools. Research in this area is critical to determine what works best for all of America's youth.

Problem Statement

The potential of single-sex classes to increase achievement dominates the discussion among educators who strive to address declines in student performance, especially in middle schools (Spielhagen, 2008c). However, there appears to be no consensus as to whether or not it is beneficial for students to be enrolled in single-sex classes within public coeducational schools (AAUW, 1998; Campbell & Wahl, 1998; Ferrara & Ferrara, 2008; Shapka & Keating, 2003). Federal legislation limited the implementation of single-sex classes within coeducational schools until 2006 when Title IX of the Education Amendments of 1972 was changed to permit public schools to establish single-sex classes within specific guidelines (AAUW, n.d.; U.S. Department of Education, 2006). It is critical to study single-sex classes within coeducational settings to ensure quality instruction for all students as schools begin to implement this option.

The current educational environment mandates accountability and evidence-based practices (Spielhagen, 2008c). Marsh & Willis (2007) defined the basic rationale of accountability as people being held responsible for their performance in an effort to identify and eliminate weaknesses. Pushing for greater accountability as an approach to school improvement culminated in the passing of the No Child Left Behind Act in 2001 (Schoen & Fusarelli, 2008). Accountability is not new to education in the 21st century. Linn (2000) identified the use of tests for program accountability in the 1960's. Marsh and Willis (2007) described increasing pressure that descended upon schools in the 1970's that then became commonly known as "accountability" (p. 56).

No Child Left Behind (NCLB) legislation established the current accountability system by establishing six state mandates (NCLB, 2001). All states must identify a set of

academic standards for core subject areas at each grade level. In addition, a state assessment system must be established to monitor student progress toward meeting state-defined standards. Schools and districts in each state are required to publish report cards identifying academic achievement of their students in aggregate, and disaggregated by ethnicity and other sub groups such as racial minorities, special education students, and students for whom English is a second language. Therefore, a system of labels is required to communicate to the community how local schools and districts are performing. A plan of adequate yearly progress (AYP) must be formulated at the state level to ensure 100% of students will reach academic proficiency by the year 2014-2015. The AYP plan must include a system of accountability that extends rewards and sanctions to schools, educators, and students that are tied to whether they meet the state's goals.

Additional federal legislation affects the availability of single-sex classes in coeducational school settings. Title IX prohibited discrimination based on sex in education programs and activities that receive federal assistance (AAUW, n.d.; U.S. Department of Education, 2003; U.S. Department of Justice, 2002): "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance" (Title IX, 2007). Complaints have been brought under Title IX alleging discrimination in academic fields such as science and math (AAUW, n.d.).

Changes in Title IX legislation now allow the inclusion of single-sex classes within coeducational public school settings (Friend, 2007; Spielhagen, 2008b; U.S.

Department of Education, 2006). The new regulations provide: enrollment in a single-sex class should be a completely voluntary option for students and their families; a substantially equal coeducational class in the same subject must be provided; non-vocational single-sex classes are permitted under the new regulations and must be substantially related to the achievement of an important objective such as improving the educational achievement of students, providing diverse educational opportunities or meeting the particular identified needs of students; if a single-sex class is provided, the objective must be implemented in a manner that treats male and female students equally; in some cases, a substantially equal single-sex class in the same subject may be required in addition to the required coeducational class; and school districts are required to conduct evaluations of their single-sex classes at least every two years to ensure their compliance with the new regulations.

Attention has been directed to the gap in math achievement between females and males. As a result, most single-sex classroom research has examined classroom inequities and female participation in math (Mael, 1998). Stein (2001) claimed the selection of instructional strategies as the most important decision a teacher makes. In mathematics, instructional strategies determine what content students have the opportunity to learn which influences their perceptions of what mathematics is.

Single-sex classes have been recommended for problematic areas (Rogers, 2008b). Gurian and Stevens (2005) and AAUW (1998) recommended the implementation of single-sex classes in math and science. Data collection for this study was limited to math classes due to insufficient enrollment in single-sex science classes.

Purpose of the Study

The purpose of this case study was to gain a better understanding of the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math within a public middle school. Ferrara (2008) received overwhelming requests from instructors for research studies in single-sex classrooms and co-educational classrooms to investigate curriculum and instruction, and gender-specific teaching strategies. In addition, Salamone (2003) recommended further qualitative study of curriculum content, teaching style, classroom interaction, and overall climate related to single-sex classes.

Theoretical Framework

Gagné's (1985) theory of instruction provided the framework for this study (See also Gagne & Medsker, 1996). His theory of instruction was developed for all classrooms and was not limited to single-sex or coeducational classroom settings. Therefore, it provided unbiased criteria to explain quality of instruction in different settings. The instructional strategies were observed within the context of instructional events. According to his theory of instruction, nine instructional events promote learning: gaining attention, informing students of the objective, stimulating recall prior to learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer (Gagné, 1985; Gagné & Medsker, 1996).

It was expected that the instructional strategies selected by the instructors will facilitate at least one of the instructional events. Gagné and Medsker (1996) described instructional strategies and a variety of practices associated with each instructional event that included, but are not limited to: gesturing; altering voice tone or volume; referring to

visual aides such as transparencies, videos, photos, or props as examples; performing demonstrations; giving verbal explanations or descriptions; providing students opportunities to practice and demonstrate learned knowledge and skills; providing feedback for student improvement; and assessing student performance.

Research Questions

1. What instructional events are incorporated in single-sex and coeducational classes?
    a. What instructional events are incorporated in single-sex classes?
    b. What instructional events are incorporated in coeducational classes?
2. What instructional strategies do instructors who teach both single-sex and coeducational math classes use in the respective classrooms?
    a. What instructional strategies are used in single-sex classes?
    b. What instructional strategies are used in coeducational classes?
3. What are challenges of the single-sex and coeducational classes?
    a. What are the challenges of the single-sex classes?
    b. What are the challenges of the coeducational classes?
4. How does the theoretical framework inform or explain the process?
5. What realities discovered in the study were not explained by the theoretical framework?

Researcher Bias

As the female researcher, I have taught 16 years within the Bedford School District (BSD). My experiences as a learner, a teacher, and a counselor have all been in a coeducational setting. However, I am open to the potential of single-sex classes and am unaware of any bias for or against the implementation of single-sex classes. I taught

science for nine years before working as a school counselor for seven years. I am currently serving the first year as an assistant principal at Bedford High School (BHS). Nastasi (2009) emphasized the importance of a "researcher's skills in establishing relationships, gaining trust, and interacting with participants" during the effective use of qualitative methods (p. 31). My experience as a teacher and counselor within BSD has provided me the opportunity to establish positive working relationships throughout the district. I am professionally acquainted with the superintendent, the principal at Bedford Middle School (BMS), and one of the teachers who will be asked to participate in the study.

A number of safeguards were incorporated into this study to protect against bias. The study was conducted in a school in which I am not employed. I do not supervise the teachers who were involved in the study and I am not in a position to influence their supervisors. I am professionally acquainted with the participants of the study; however, I did not have a personal relationship with any of them. I hold teacher certification in a different field of study; therefore, I focused on instructional events and strategies without comparing them to any previous experience. My career experience has been exclusively at the high school level, and I had no pre-conceived expectations of student behavior or teacher choices at the middle school level.

I completed the Philosophy of Adult Education Inventory (Zinn, 1983) in one of my graduate courses which indicated that my philosophy of adult education is primarily behaviorist. After reviewing the basic principles of behaviorism in Elias and Merriam (2005), I was able to confirm that my personal philosophy of education is grounded firmly in behaviorism. The behaviorist philosophy underscores the importance of

consequences that reinforce behavior. That philosophy has impacted education by contributing to the development of behavioral objectives, accountability standards, and instructional methods that include programmed instruction, computer-assisted instruction, and contract learning.

Need and Significance of the Study

It is hoped that this study contributes to the knowledge of single-sex classrooms within coeducational schools. Recent changes in Title IX legislation allow schools greater flexibility in offering single-sex classes within coeducational schools. Friend (2007) identified equity of educational practices as an essential key to the debate over single-sex classes.

This study may also contribute to policy development at the local, state, and national level. There is growing interest in the development of single-sex classrooms now that the prohibitive regulations of Title IX have been changed. Research is needed to guide sound policy development.

Ferrara (2008) suggested the application of differentiated instructional practices implemented in single-sex classrooms may be used in coeducational classes. The study of instructors who taught both single-sex and coeducational math classes may also contribute to the practice of differentiated instruction.

Lastly, this study may contribute to the body of research in the United States. Salamone (2003) identified Australia as the first country to embrace the benefits of single-sex classrooms followed by Great Britain. Much of the research on single-sex classrooms has been conducted in these two locations.

Assumptions

It was assumed that these instructors who taught in single-sex classrooms had received training in the area of differentiated instruction specifically related to single-sex populations. Professional development has been noted as a vital component to the success of single-sex classes (Cable & Spradlin, 2008; Ferrara & Ferrara, 2008; Gurian & Stevens, 2005; Leonard, 2006; Rogers, 2008b). Secondly, it is assumed that the school is in compliance with the requirements of federal law, specifically Title IX legislation as it is applied to single-sex classrooms.

Limitations

Limitations of the study included voluntary selection of the single-sex classes, the limited number of available research sites for the study, and technical difficulties related to video-recording strategies. Title IX provisions require enrollment in single sex classrooms to be a completely voluntary option for students and their families. Shapka and Keating (2003) identified voluntary selection as a limitation in research of single-sex classrooms. In addition, they identified the lack of control used to explain pre-existing differences as an additional limitation of some studies of single-sex classrooms. A related limitation included non-equivalent group comparisons as identified by Marsh (1989).

Another limitation included the purposive sampling strategy used for this study. Only one school district within a 570 square mile area had established both single-sex and coeducational math classes taught by the same teacher. In addition, Patton (2002) identified qualitative findings as generally dependent on current conditions of the sample. Stake (1995) and Creswell (2003) agreed that case study strategies are bound by the current setting, including time and activity.

An additional limitation included difficulties arising as a result of video-recording technology. In addition to technical difficulties, Nastasi (2009) identified the time and labor intensive work of recording, transcribing, and coding as a disadvantage of video-recording. However, having a permanent video record of observations that allowed for in depth analysis and participant review outweighed the possible limitations.

Patton (2002) identified limitations associated with potential data sources. Limitations of observational data included ways in which the case is affected unknowingly by the presence of the observer or of the recording equipment. In addition, observational data are limited to external behaviors and to small samples of activities. Limitations of interview data included personal biases and expectations, emotional states, and politics. Limitations of document data may have included inaccuracies or incomplete information. The researcher sought to overcome the weaknesses of some data sources with the strengths of other data sources by including a variety of data sources.

Definition of Terms

Assessing performance:

Instructional event in which learning the objective at a level of proficiency is verified and supports the internal process of retrieval and reinforcement (Gagné, 1985; Gagne & Medsker, 1996).

Coeducational Classes:

Classes containing a combination of female and male students.

Eliciting performance:

Instructional event in which the instructor asks students to demonstrate knowledge of the new skill that supports the internal process of responding (Gagné, 1985; Gagne & Medsker, 1996).

Enhancing retention and transfer:

Instructional event in which opportunities are given to practice new skills after assessment that support the internal processes of retrieval and generalization (Gagné, 1985; Gagne & Medsker, 1996).

Expectancy:

Motivation students may have to obtain an objective that has been set before them (Gagné, 1985).

Gaining attention:

Instructional event consisting of rapid changes in stimulus that supports the internal process of stimulus reception (Gagné, 1985; Gagne & Medsker, 1996).

Informing students of the objective:

Instructional event in which the instructor informs students what they will be able to do after learning which supports the internal process of expectancy (Gagné, 1985; Gagne & Medsker, 1996).

Instructional Events:

External processes that support internal processes of learning based on information-processing theory of learning (Gagné, 1985; Gagne & Medsker, 1996).

Instructional Strategies:

Teaching practices to be utilized; synonymous with instructional techniques discussed by Gagné & Medsker (1996).

Presenting the content:

Instructional event in which the instructor presents new information related to the objective to be learned which supports the internal process of selective perception (Gagné, 1985; Gagne & Medsker, 1996).

Providing feedback:

Instructional event in which the instructor gives students informative feedback about their performance that supports the internal process of reinforcement (Gagné, 1985; Gagne & Medsker, 1996).

Providing learning guidance:

Instructional event in which the instructor suggests to students a meaningful organization of new information that supports the internal process of semantic encoding into long-term memory storage (Gagné, 1985; Gagne & Medsker, 1996).

Retention:

The ability to reproduce learned behavior after a period of time has elapsed since the last performance (Gagné, 1985).

Single-Sex Classes:

Classes containing either female students only or male students only.

Stimulating recall prior to learning:

Instructional event in which the instructor asks students to recall previously learned knowledge or skills which supports the internal process of retrieval to working memory (Gagné, 1985; Gagne & Medsker, 1996).

Transfer:

The ability to use the learned skill in a different situation than the ones in which it was learned (Gagné, 1985).

Summary

School officials consider single-sex classrooms in the midst of accountability standards and federal legislation. However, questions remain regarding the issues faced when single-sex classrooms are implemented and maintained. Gagné's (1985) theory of instruction provided the theoretical framework for this case study which examined the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math. The research questions focused on the instructional events, strategies, and challenges within single-sex and coeducational classrooms.

This study may contribute to the general body of knowledge of single-sex classrooms in coeducational settings and to policy development at the local, state, and national levels. It was assumed the instructors received professional development related to single-sex classrooms and that the school was in compliance with federal legislation. Limitations of the study included a Title IX regulation that requires voluntary selection of single-sex classrooms, the lack of schools offering established single-sex classrooms where the instructor also teaches coeducational classes, and the challenges of video-recording in the classroom.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this literature review was to provide information related to the study of single-sex and coeducational math classrooms within a public middle school. It begins with the historical context of single-sex education in the United States and progresses to current legislative changes that allow for the introduction of single-sex classrooms within certain guidelines.

The advantages and disadvantages of single-sex classrooms are discussed, but the overall results are inconclusive. These inconclusive results make the study of single-sex classrooms controversial in nature, fueling strong debates between proponents and opponents of single-sex classrooms. As a result, there may be political and social implications for studying and reporting on single-sex issues.

Much of the controversy surrounding single-sex classroom options stems from differences and similarities between the sexes. Current technologies have allowed the continued progression of brain and neuroendocrine research. Differences occur in brain structure and hormonal levels between males and females. These variations result in different patterns of development. In addition, students who enter middle school are experiencing developmental changes as well as institutional changes from elementary school to the middle school. Therefore, an instructor's differentiated approach to math

instruction may benefit both males and females.

Gagné's (1985) theory of instruction provided the lens for analyzing instructional events and strategies that occurred within the single-sex and coeducational classrooms. He proposed nine instructional events related to internal processes of learning and provided some instructional strategies by which the instructional events may be accomplished within the classroom.

Video-recording, recommended as a tool to study classrooms, had advantages and disadvantages. However, the benefits of analyzing the same data multiple times from various perspectives outweighed the disadvantages.

Historical Context of Single-Sex Education in the U.S.

Research on gender and education is an immense field (Weaver-Hightower, 2003). It is important to remember that the educational theory on which our school system and our instructional methods are based developed from social thought that originated four to six decades ago (Gurian & Stevens, 2005). However, the history of single-sex education in the United States goes back much further. Even though coeducation was the dominant practice between the late 1800's and 1960, single-sex public education was an option in larger cities in the eastern and southern regions of the United States (Jost, 2002; Riordan, 1990). Catholic and Jewish private schools were primarily single-sex while Protestant schools were primarily coeducational (Riordan, 1990).

Historically, the most substantial investigation of single-sex and coeducational difference is Dale's extensive research program conducted in England and Wales. He has written on the subject of coeducation for more than 25 years, from 1948 to 1974, with a

definite tilt in favor of coeducation. His work is extensive, assertive, and policy oriented (Marsh, 1989).

Dale (1969) reported the type of grammar school favored by educators in Glamorgan, a county in Wales, after surveying 215 co-educational staff and 335 single-sex staff. Participants chose from the following options: complete co-education, coeducation with some single-sex classes, dual schools, and single-sex schools. The response was overwhelmingly in favor of the complete coeducation option. Coeducational school staff returned 84% of the replies in favor of complete co-education, 7% in favor of coeducation with some single-sex classes, 2.3% in favor of dual schools, 3.8% in favor of single-sex schools, and only 4% were undecided. Educators in boys' schools returned 51% replies in favor of complete coeducation, 10% coeducation with single-sex classes, 11% in favor of dual schools, and 22% in favor of single-sex schools, with 6% undecided. Educators in girls' schools returned 41% replies in favor of complete coeducation, 13% coeducation with single sex classes, 16% in favor of dual schools, 18% in favor of single-sex schools, and 11% undecided. A large majority of the educators within coeducational schools preferred their own system while a majority of the educators within single-sex schools voted against their own system and preferred coeducation.

When comparing preferences of educators who have taught in both coeducational and single-sex settings, Dale (1969) found that 60% of educators who taught in both single-sex and coeducational grammar schools, and were educated in single-sex schools, were in favor of complete coeducation. In addition, he found that 78% of educators who

taught in both single-sex and coeducational grammar schools, and were educated in coeducational schools were in favor of complete coeducation in secondary schools.

During the Progressive Era, John Dewey's followers urged the creation of the comprehensive coeducational high school to provide a wide range of courses to all students, as suited to their needs (Speilhagen, 2008a). Early feminists supported this reform because, in theory, these schools would provide access to the entire curriculum to all students, particularly girls, who previously were provided limited opportunities. Girls were inhibited particularly in the areas of math and science (Spielhagen, 2008a). Before the early 20th century, single-gender schools were common, but education for women was limited to basic skills courses and did not include academic subjects that would lead to higher education (Spielhagen, 2008b). Historically in the U.S., single-sex schools were favored as a symbol of quality education that was not found in a coeducational school environment (Ferrara & Ferrara, 2008).

Conditions in the larger society around gender roles and expectations have changed dramatically since the research on gender was initiated in the early 1970's (Campbell & Wahl, 1998). When they began their research, in the 1960's and 1970's, there was a great deal of bias against females in adult and child communities (Gurian, Henley, & Trueman, 2001). Rhetoric about the effectiveness of single-sex classes dominated the last years of the 20th century, with conflicting opinions over how much boys or girls benefited, if at all, by the arrangement (Spielhagen, 2008a). At the same time, policy makers in education looked to single-sex classes as a solution for declining achievement in particular content areas, specifically mathematics and science for girls and language arts and reading for boys (Spielhagen, 2008a).

In the U.S., such discussions of gender arguably reached their peak in the early 1990's with the publication of a number of reports and popular books about the educational disadvantage of girls (Weaver-Hightower, 2003). An American Association of University Women (AAUW) study, *How Schools Shortchange Girls* (1992), reported results based on a synthesis of available research: males received significantly more attention and more esteem-building encouragement than females; sexual harassment of girls by boys was on the rise; contributions of females was marginalized or ignored in textbooks; differences in math achievement between males and females was small and declining; females were less likely than males to pursue the highest level math courses; and females were less likely than males to pursue scientific or technological careers among their conclusions. Their first recommendation for policy was to strengthen the reinforcement of Title IX legislation.

Gurian, Henley, and Trueman (2001) analyzed research on gender bias and reached the conclusion that both boys and girls are affected by gender disadvantage in schools. They argued that the harshest gender disadvantage existed against boys, that girls are more likely to express negative feelings and detail negative experiences in the school, and they asserted that interpreters of the AAUW (1992) study presented their findings as proof that schools were biased against girls, without informing the public that boys are, in general, more hesitant to (1) share feelings about any experience and (2) share specific details about an experience in which they have suffered pain or disadvantage (Gurian, et al., 2001). Two reasons exist for their claim that their conclusions differ from the AAUW. The first is how the study was carried out and reported, including underlying assumptions and lack of a biological foundation. When the

AAUW found that boys were called on more than girls in class, they assumed the girls were being discriminated against, without looking further into the fact that much of the attention boys received in class was disciplinary in nature. In addition, Gurian et al. pointed out that girls who were not called on frequently outperformed the boys. Being addressed was not necessarily an indicator of academic success or failure, but researchers of the AAUW study decided to consider it as the main indicator. The second reason is the passion of women's advocates to address bias against females in the adult workplace by showing that similar bias exists in the educational community (Gurian, et al., 2001).

Hyde and Lindberg (2007) expressed concern that most researchers hold a deep belief that differences in mathematics performance between the sexes exist. As a result researchers devote their resources to documenting those differences. This persistent search is what Caplan and Caplan (2005) identified as the "perseverative search for sex differences" (p. 25). Hyde and Lindberg (2007) issued a cautionary warning for researchers to be aware of the bias toward finding gender differences and ignoring the similarities between the genders. They urged researchers to balance their reporting of differences and similarities.

The debate over single-sex education circulates around two concerns (Salamone, 2003). One is whether it is legal to offer single-sex classes within public schools and the other is whether it produces educational benefits for females or males. The original purpose of single-sex classes was to provide opportunities for students, specifically those in the middle school grades, to focus more on their academic learning rather than on social concerns (Ferrara, 2008). In addition, she found single-sex classes provide "safe and comfortable" environments where girls may gain skills and confidence in the areas of

math, science, and technology. Gurian and Stevens (2005) found that implementation of single-sex classes is initially driven by the need to improve standardized test scores that measure competency in math, language arts, science, and social studies. The result of the single-sex classroom movement has been a closer look at what is taking place in the classroom and specifically in the academic learning of males and females (Ferrara, 2008).

The availability of single-sex programs in public schools was closed during the last three decades of the 20th Century through policy and litigation. However, NCLB provided schools the opportunity to offer single-sex classes (Friend, 2007). In addition, recent changes in Title IX of the Education Amendments of 1972 made single-sex classes within public coeducational schools a viable option. The growing popularity of single-sex classes has also gained momentum in other countries, namely Australia, New Zealand, the United Kingdom, and Ireland (Ferrara and Ferrara, 2008).

Recent Changes in Title IX

The U.S. Department of Education confirmed the legality of single-sex classes and schools in 2006 (Friend, 2007; Spielhagen, 2008b). U.S. Secretary of Education Margaret Spellings announced changes in Title IX regulations that gave communities more flexibility to offer single-sex classes to meet the needs of students (U.S. Department of Education, 2006). The new regulations amended previous requirements of Title IX of the Education Amendments of 1972 which prohibit sex discrimination in education programs or activities receiving federal funds. Enrollment in a single sex class should be a completely voluntary option for students and their families. In addition, a substantially equal coeducational class in the same subject must be provided. Non-vocational single-sex classes are permitted under the new regulations and must be substantially related to

the achievement of an important objective such as improving the educational achievement of students, providing diverse educational opportunities or meeting the particular identified needs of students. If a single-sex class is provided, the important objective must be implemented in a manner that treats male and female students even-handedly. In some cases, a substantially equal single-sex class in the same subject may be required in addition to the required coeducational class. The new regulations also require that school districts and private schools conduct evaluations of their single-sex classes at least every two years to ensure their compliance with the regulatory requirements.

Riordan supported the proposed changes to Title IX regulations based on a need for additional research (Jost, 2002). He viewed the change in Title IX requirements as a step toward increasing the number of single-sex schools and classrooms, thus increasing the opportunities for conducting research that would lead to a better understanding of the effectiveness of single-sex schools and classrooms.

Sadker opposed the changes to Title IX regulations (Jost, 2002). Like Riordan, he recognized the need for research on single-sex schools. However, he expressed a concern that creating schools as opposed to examining them would result in the misuse of such schools. Without a controlled implementation of single-sex options, there would be limited opportunity to examine and ultimately understand why these options succeed or fail. Finally, he claimed that creating single-sex schools sets up a historical condition of separate and unequal resources and funding.

The Association of American University Women opposed the change in Title IX regulations for a number of reasons (AAUW, n.d.). Members of AAUW believed single-sex education without proper attention to civil rights protections can strengthen

problematic gender stereotypes, increase discrimination, and restrict the educational opportunities open to both girls and boys. One explanation for their lack of support is that the regulations are equivalent to an executive order that undermines the principles upheld in *Brown v. Board of Education* (1954). In addition, the regulations proposed no accountability or reporting requirements that are consistent with NCLB. The regulations require schools to evaluate their single-sex practices every other year, but do no require them to report the evaluations. In addition, the evaluations are not required to be scientifically valid or reliable. The regulations take attention away from other problems in education (e.g., fully funding programs and mandates authorized in NCLB). Originally, Title IX allowed flexibility for schools to segregate students by sex when there was a legitimate reason to do so, while maintaining civil rights protections. Examples included physical education, sex education, and choral groups. The new regulations require more resources than most schools can afford. The goals of single-sex education will not be uniform, and the most basic safeguards are thrown out. They claim the regulations do not identify what is meant by "substantially equal." AAUW does not oppose the idea of single-sex education, so long as it is appropriate, necessary, and done in a manner consistent with constitutional requirements and existing antidiscrimination laws. The regulations rely on unproven assumptions about the benefits of single-sex programs.

The AAUW (n.d.) supports pilot and voluntary single-sex classes that meet specific criteria including complying with civil rights laws, being introduced in response to demonstrated need, and being designed to inform and improve the coeducational public school. However, they do not believe the new regulations are rigorous enough to

ensure adequate civil rights protections, and do not put safeguards in place to limit the problematic stereotypes that have historically limited girls' opportunities.

Advantages of Single-Sex Classes Within Coeducational Schools

Establishing single-sex classes within coeducational schools has been identified by Gurian and Stevens (2005) as a relatively efficient option compared to converting a whole school from a coeducational to single-sex setting. In addition, Shapka and Keating (2003) identified students' preference for attending coeducational schools. Others agree that one way to maximize the benefits and minimize the risks of single-sex classes is to offer single-sex classes within a coeducational school (AAUW, 1998; Gurian & Stevens, 2005; Shapka & Keating, 2003). Leonard (2006) found that both boys and girls prefer some single-sex classes in coeducational schools. Although, Jackson (2002) found that girls largely favored single-sex classes and boys were more unresolved in their support of single-sex classes.

Single-sex classes have been identified as an effective learning environment for both boys and girls. Gurian and Stevens (2005) identified major international studies from Australia, Canada, England, and the United States that have demonstrated that single-sex classes can help both boys and girls. In addition, when combined with other learning interventions, single-sex classes can enhance the learning environment for all students (Ferrara & Ferrara, 2008). Specifically, Friend (2007) identified multiple research findings that documented higher academic achievement and more positive student attitudes for male and female students who are from low socio-economic or racially/ethnically diverse backgrounds.

Single-sex classes have been connected with self-concept, self-esteem, and stereotype threat. Jackson and Smith (2000) examined the impact of single-sex math classes in a British coeducational school and found that self-concept increased during the time students attended single-sex classes. AAUW (1998) found that gains in self-esteem were evident for some students in single-sex classes. Huget and Régner (2007) found that boys and girls performed better in the single-sex classes and identified the elimination of stereotype threat as an argument for establishing single-sex classes. Stereotype threat has been defined as the risk of being judged according to the terms of a negative stereotype (Steele, 1997). For example, female students may conform according to the negative stereotype that females are not as good in mathematics as males and as a result perform poorly on the mathematics exam (Davies & Spencer, 2005; Halpern, Wai, & Saw, 2005; Hyde & Lindberg, 2007).

Gurian, Henley, and Trueman, (2001) recognized two benefits of single-sex classes: the removal of the psychosocial stress, primarily interpersonal stressors, from the learning environment, and the avoidance of competition between the sexes. They recognized that not all competitions and stresses are removed within single-sex classes, but stressors culturally imposed may be minimized. In addition, Ferrara and Ferrara (2008) found that separating boys and girls reduces levels of distraction and peer pressures between males and females. Spielhagen (2008b) emphasized the opportunity for students to interact with the opposite gender throughout the day when single-sex classes are established within coeducational schools. Gurian & Stevens (2005) identified other opportunities students have to interact together and to develop interpersonal relationships outside the single-sex classroom.

Marks and Burns (2008) reported better grades, better attendance, and better behavior as a result of single-sex classes. Ferrara (2008) found that students in single-sex classes had improved attendance compared to their attendance the previous year in coeducational classes. Single-sex classes may be implemented as a way to create a safe and positive learning environment (Spielhagen, 2008c). Ferrara and Ferrara (2008) reported decreases in student discipline referrals from the single-sex classes, most notably in the male classes. They emphasized that students in the single-sex classes may learn with fewer disciplinary distractions than students in the coeducational classes. Rogers (2008a) found that teachers tended to be more interactive with wider groups of students in the single-sex classes. In addition students were more interactive with the teacher and their peers in the single-sex classes.

Rogers (2008b) recommended offering single-sex classes for academic areas that become problematic. Gurian and Stevens (2005) identified single-sex classes as a powerful innovation for math and science. AAUW (1998) recommended single-sex classes as a method to reduce identified gender biases in the areas of math and science. Gagné's (1985) theory of instruction was developed for all classroom settings and was not limited to single-sex or coeducational classroom settings. Therefore, it provided unbiased criteria to explain quality of instruction in different settings (See also Gagne & Medsker, 1996).

Advantages of single-sex classes specifically for boys include academic gains and behavioral improvements. Friend (2007) reported increases in male student achievement in math and reading after a year in single-sex classes. The decrease in the number of disciplinary referrals within single-sex classes had a direct effect on boys because boys

outnumber girls, sometimes 10 to one, in the number of disciplinary referrals (Gurian & Stevens, 2005). They also recognized that boys who suppressed their creative talents in the coeducational classes became more engaged in creative arts, music, and drama when single-sex classes were available in those subjects. They identified single-sex classes as safe environments for boys to ask questions of masculinity that they may not ask in a coeducational setting. The opportunity for open communcation allows for a deeper dialogue between the boys. Gurian, Henley, and Trueman (2001) found that boys learn self-management when engaged in single-sex classes.

Shapka and Keating (2003) suggested that females reap more benefits of single-sex classes than males. Spielhagen (2008c) added that single-sex classes were particularly advantageous to girls in the middle school grades. Mael (1998) found single-sex math classes in early adolescence were beneficial to the performance of girls. In addition, single-sex classes have been particularly helpful in opening up educational and career opportunities for girls in all areas of success (Gurian & Stevens, 2005; Marks & Burns, 2008; Shapka & Keating, 2003). Rogers (2008b) found that girls experience more positive interactions consistently in single-sex classes. Gurian, Henley, and Trueman (2001) pointed out that the girls' psychosocial self-confidence increased along with academic performance.

The success of single-sex classes has been attributed to administrative leadership, committed instructors, and professional development particularly in the area of differentiated instruction specifically related to single-sex populations. Rogers (2008b) claimed that administrative leadership has a significant effect on whether the implementation of single-sex classes is successful or not. Gurian and Stevens (2005)

emphasized the positive impact of committed instructors to the success of single-sex classes. The most frequently cited factor contributing to the successful implementation of single-sex classes was professional development (Ferrara, 2008; Ferrara & Ferrara, 2008; Gurian & Stevens, 2005; Leonard, 2006; Marks & Burns, 2008; Rogers, 2008b; Spielhagen, 2008c).

Disadvantages of Single-Sex Classes

AAUW (1998) acknowledged that single-sex classes can be an empowering option because they can be a safe place for learning and discussion while at the same time can be an oppressing option because they may reinforce sex stereotypes. Huget and Régner (2007) agreed with this sentiment. They stated that single-sex classes may help prevent stereotypes from affecting testing situations, but that they are detrimental to stereotype formation and propagation.

There are conflicting findings regarding the approach of teachers in single-sex classes. Leonard (2006) found that teachers adapted their teaching styles to the perceived learning style of the boys. These adaptations included quick-paced, short-term tasks, while encouraging greater emotional openness and particularly challenging the boys' stereotypical views of the 'feminine nature' of language-based subjects. He also acknowledged warnings that development of single-sex classes can homogenize all males and all females and that stereotypical behavior could be reinforced if teaching were to focus on the areas where boys are already strong and ignore their areas of weakness. Ferrara and Ferrara (2008) found that teachers in the single-sex classes did reinforce traditional gender stereotypes. They observed teachers who provided instruction for boys

in a more regimented, traditional, and individualist fashion and girls in a more accepting, cooperative, and open environment.

AAUW (1998) stated that the creation of single-sex classes does not ensure the environment will be free of sexism or traditional stereotypes of male superiority. Single-sex classes and schools can reinforce stereotypes about men's and women's roles in society just as coeducational settings can. In addition, they suggested that the decision to implement single-sex classes has little to do with the classes' effectiveness. They suggested that creating single-sex classes without providing for teacher training or other support would probably not be enough to create meaningful change. In addition, they pointed out that single-sex classes may affect other coeducational classrooms by skewing the sex ratio in those classes.

Friend (2007) identified implications of single-sex classes to include potential inequities caused by reinforcement of gender stereotypes or an absence of accountability for public schools choosing to implement single-sex classrooms. She pointed out that public schools are not accountable to any agency to provide data or documentation of a rationale for single-sex classes.

Parents have voiced concerns about the lack of socialization opportunities as a result of the development of single-sex classrooms (Gurian & Stevens 2005). They found that some parents believe that boys and girls who are separated into single-sex classrooms will miss out on important socialization opportunities that will prepare them for building successful relationships in their future. They also found that some students admit they miss the social aspect of coeducational classes.

Leonard (2006) indicated that teachers may find the all-girl classes less

challenging or less interesting and the all-boy classes, particularly those of low-ability to be particularly difficult to manage and control. AAUW (1998) found that some girls view the single-sex classes as a refuge from boys' intimidation. However, some boys found themselves getting picked on due to the absence of girls. Rogers (2008b) acknowledged that boys interact differently in single-sex classes than boys in coeducational classes. They also interact differently than girls in single-sex classes. Spielhagen (2008b) suggested that further analysis might reveal a pattern of bullying emerging over time, especially in the all-male environment.

The implementation of single-sex classes should be considered with caution (AAUW, 1998; Friend, 2007; Huget & Régner 2007; Hyde & Lindberg, 2007). AAUW (1998) discourages school leaders from considering single-sex classes solely to provide a good education. Friend (2007) advised school leaders to consider the historical legacy of gender and racial inequities found in separate educational settings before creating single-sex classes. Huget and Régner (2007) cautioned school leaders to consider the gains in student performance in the classroom versus the tension and discrimination outside the classroom when determining the appropriateness of single-sex classes. Hyde and Lindberg (2007) cautioned educators about arguments that rely on assumptions of large psychological differences between males and females. They claim that males and females are very similar on most relevant variables.

Inconclusive Results

There is a lack of evidence that single-sex education is effective in improving student achievement. The AAUW (1998) determined there was no evidence that single-sex education is better than coeducation for the general population. They also conceded

that success of single-sex education is relative to a specific group of students in a particular setting and a given set of objectives. In addition, Shapka and Keating (2003) identified three different studies (See also Lee & Bryk, 1986; Marsh, 1989; & Riordan, 1990) who used the same large scale, nationally representative longitudinal database that followed thousands of students over a six-year period, the High School and Beyond database, and resulted in contradictory conclusions related to the benefits of single-sex education compared to coeducation in Catholic high schools.

Test scores play a significant role in determining the educational success or failure of students and school reform efforts like single-sex education. Spielhagen (2008c) concluded that single-sex classes benefit some students in some classes, but do not guarantee better academic achievement as measured by standardized tests. In addition, Mael (1998) identified the argument that test scores may be manipulated in ways that result in false advantages or disadvantages.

Better test scores may not be a result of single-sex classes alone. Friend (2007) suggested additional variables may have accounted for improved test scores in addition to single-sex classes. She identified differences in the initial ability levels between the single-sex class and the coeducational class as one possibility. In addition, more emphasis placed on motivating students in the single-sex classes to take the tests seriously and to do their best may have also played a significant role in improving test scores. Other variables that were identified included extended school year and smaller classes. Leonard (2006) identified improved instructional methods as the source of improvement in single-sex classes for boys as opposed to the gender make-up of the class itself.

Hyde and Lindberg (2007) identified and discussed a number of methodological issues that contribute to the confusion and assumptions within the research of psychological gender differences. One issue is the focus on statistical significance without including effect size that communicates the magnitude of the differences between males and females. Another issue is the reliance on individual studies without confirming replicated results. They identified sex bias in testing and measurement as another issue. In addition, they identified inaccurate causal links based on correlational or quasi-experimental data. Finally, they identified researchers' personal bias as a hindering methodological issue. Within the meta-analysis of mathematics performance conducted by Hyde, Fennema, and Lamon (1990), 51% of the studies indicated males scored higher than females, 6% of the studies reflected no difference between males and females, and 43% of the studies showed females scored higher than males. Hyde and Lindberg (2007) pointed out the ease of finding a study that supports one's personal beliefs.

Coeducational Classes

Thomas Jefferson proposed three years of public education for both boys and girls in Virginia in 1779 (Riordan, 1990). Until 1821, grammar schools and academies served as feeders to specific colleges. The majority of these schools were coeducational primarily in the sense that both males and females attended. However, recreation and socialization between the sexes was discouraged during this time in history.

Both males and females could attend public elementary and high schools by the end of the nineteenth century (Riordan, 1990). Kolesnik identified the first coeducational high school, established in 1840, in Lowell, Massachussetts (as cited in Riordan, 1990). In 1901, the U.S. Commissioner of Education reported 98% of public high schools in the

United States as coeducational (as cited in Riordan, 1990). Spielhagen (2008b) credited coeducational classes with providing opportunities for girls to participate in pre-collegiate study resulting in considerable increases in the college enrollment of girls across the nation.

Riordan (1990) described five cases for supporting coeducation. The original case of support for coeducation stemmed from economic necessity. Sparsely populated areas of the country simply could not afford to provide separate educational resources for males and females. A second case presumed that educating males and females together is "natural" (p. 40). Coeducation provides males and females opportunities to learn how to work together. A third case focused on the potential for reducing gender stereotypes within coeducational classrooms. A fourth case centered on the preparation of males and females for less differentiated gender roles in society. The final case emphasized the importance of equal educational opportunities for both males and females.

Additional support for coeducational school settings focused on educational effects on males and females, preparation for life, general discipline, and work (Dale, 1969). It was reported that the presence of both females and males has a diminishing effect on the extreme forms of behavior characteristic of each group. It was claimed that "each sex unconsciously behaves better in front of the other group" (p. 38). In addition, comments from educators indicated males and females get to know each other in the everyday life of the classroom which provides them the opportunity to learn how the opposite sex thinks and reacts while both acquire a respect for the abilities of the other. The educators pointed out that students will be better prepared for life in the world by being given opportunities to interact together and not by keeping them apart. Educator

comments about general discipline maintained that the discipline of a coeducational school tends to be better than that of a boys' school because the presence of the girls makes the boys less boisterous. The educators argued that there is a friendly spirit of competition between the sexes in the classroom that prepares students for futures within the workplace.

Educators' comments against coeducation focused on social relationships, educational concerns, and school atmospheres (Dale, 1969). There were concerns that combining males and females in a coeducation setting resulted in a tendency for females to be neglected in favor of the males and a lack of refinement. Educators commented on the various rates of development between males and females and the distractions that affect their educational progress. There was some concern expressed that the competition between the sexes had a negative effect on some students, primarily the females. There was also argument that the presence of males had a negative effect on the females.

Brain-Based Research of Sex Differences

Gurian et al. (2001) proposed the combination of three fields to define brain-based research related to sex differences. One is the biology field including neurological and hormonal effects on learning and behavior. A second is the gender comparison research which includes environmental and neurobiological similarities and differences between males and females. The third is the field of developmental psychology particularly the effects of human development cycles on learning and behavior.

They credit current technologies such as MRI's and PET scans for enabling scientists to observe how brain structures, blood flow, and neurotransmission varies with gender. They generated a comprehensive list of brain structures and how the functions of

those structures vary between males and females. For example, sensory information focused on high levels of emotional content moves to the cerebral cortex of the female brain and to the amygdala in the male brain. The cerebral cortex is the outer portion of the cerebrum which is divided into the temporal, frontal, parietal, and occipital lobes (Bailey, n.d.). It is responsible for processing sensory information. The amygdala is located deep within the temporal lobe and is responsible for controlling emotional responses and autonomic responses to fear. As a result the female may be more likely to reason and verbalize the emotional content. On the other hand, the male may be more likely to become physically aggressive as a fight response or to become withdrawn as a flight response (Gurian et al., 2001).

Paus (2009) described differences in brain structure between males and females before, during, and after adolescence. One difference was brain size even after accounting for sex differences in body height and weight. Overall, the male brain was about 10% larger than the female brain. Additional differences included sizes of various brain regions between the sexes and volume of white matter. The amygdala and the hippocampus were larger in males than in females. The hippocampus is located adjacent to the amygdala and is responsible for navigation and spatial orientation in addition to memory consolidation and emotional responses (Bailey, n.d.). On the other hand, the brains of females appeared to have more white matter forming the corpus callosum, internal and external capsule, and optic radiation which indicates greater connections between the right and left hemispheres of the posterior temporal regions of the brain. White matter consists of nerve fibers that are surrounded by a myelin sheath that increases the speed of transmission of all nerve impulses (University of Maryland

Medical Center, 2009). However, differences in the volume of white matter between the sexes were not observed when expressed as a percentage of total brain volume (Paus, 2009).

Gurian et al (2001) identified brain structure development as a causal factor of female and male dominance in various aspects of different fields. They indicated males generally have more development than females in areas of the right hemisphere that result in better spatial abilities such as measuring and design. They indicated females generally have more development than males in the pre-frontal lobes and occipital lobes which result in better executive decision making and sensory processing. They also suggested that, as with most aspects of chronological human development, the brains of females generally mature earlier than the brains of males. Galambos, Berenbaum, and McHale (2009) confirmed that brain development occurs on a different time schedule for females and males.

Meta-analyses are available that address spatial abilities in males and females (Hyde & Lindberg, 2007). Linn and Petersen (1985) reported a significantly large magnitude of gender difference favoring males for the spatial rotation variable. Spatial rotation was defined as the ability to mentally rotate objects in three dimensions. Voyer, Voyer, and Bryden (1995) confirmed the gender difference for spatial rotation, although at a moderate magnitude. Hyde and Lindberg (2007) found gender differences in spatial rotation to be important because some hypothesize gender differences in geometry and trigonometry are due to differences in spatial rotation abilities. They also emphasized spatial rotation as a critical ability for success in some occupations in which females are underrepresented, like engineering.

Kuhn (2009) reported two types of change that occur within the brain during puberty. The first change is a wave of overproduction of gray matter that is followed by a reduction of neuron connections that do not continue to be used. The second change is an increase in white matter in which established neuron connections are further insulated improving their efficiency. As a result, both males and females have fewer, more selective, yet stronger and more effective neuron connections at the end of puberty than they did as children.

In addition to structural differences in the adolescent brain, hormonal differences within the brain have also been identified. Galambos et al. (2009) asserted that hormones play a role in gender development. They claimed that hormones affect gendered activities and interests and some personal social attributes. They also indicated that hormone effects at adolescence were controlled to some degree by social conditions. It has not yet been determined if the changes in the hormonal environment play a causal role in sex differences in brain structure and function during puberty or not (Paus, 2009).

Gurian et al. (2001) gives credence to the involvement of hormones in sex differences in both emotional functioning and in learning performance. Predictably, they identified the roles of estrogen and testosterone in neurological changes in sex drive, attitudes, and behaviors including irritability and aggressiveness. They reasoned that surges of testosterone in both sexes swell the amygdala which is part of the limbic system that generates feelings of fear and anger. As a result, many males seek outward dominance and aggression. In addition, they claimed males scored higher on spatial exams like math tests and scored lower on verbal exams when testosterone levels were high.

In addition, Gurian et al (2001) pointed out that the hormone cortisol affects the learning process by forcing the brain to focus on emotional and survival stress as opposed to intellectual learning. They indicated that the pecking order of males may have an effect on learning due to varying levels of cortisol and that males at the top of the pecking order secrete less cortisol than males at the bottom of the pecking order as a result of perceived stress and feelings of worthlessness.

They explained that surges of estrogen during puberty result in sudden growth of the hippocampus, the brain structure that is responsible for memory. Contrary to Paus (2009), Gurian et al. (2001) claimed the hippocampus in females grows larger than that in males resulting in better memory. Also, the hormone progesterone results in bonding relationships. They claimed that females scored higher on standardized and in-class tests when estrogen levels were high compared to times when it was low. Paus (2009) recommended acquiring data during different phases of the female menstrual cycle to provide answers regarding the causal influences of female sex hormones on brain development.

Additional chemical differences within the brain have been discussed by Gurian et al (2001), specifically the differences in the amounts of serotonin and oxytocin. There is an inverse relationship between the level of serotonin and the degree of impulsive behavior. The male brain secretes less serotonin than the female brain which results in a higher degree of impulsive behavior in males. A direct relationship exists between the level of oxytocin and the degree of empathic behavior. Oxytocin is more constantly stimulated in the female brain than in the male brain increasing the female's capacity to respond with empathy to the pain and needs of others.

Considering the general differences between female and male brains, Gurian et al (2001) proposed brain development as occurring along a spectrum as opposed to developing within two opposite poles of female and male ends. Generally, female brains will develop along the female end of the spectrum and male brains will develop along the male end of the spectrum. However, there are some females at the male end of the spectrum and some males at the female end. They also considered the inclusion of "bridge brains," females and males who have nearly equal qualities of both female and male brains. They are the bridge between the male and female ends of the spectrum and provide a greater understanding between male and female cultures because their brains are the most "bi-gender" (p. 16).

Gurian et al. (2001) recommended that teachers treat students as individuals and to avoid stereotyping female and male students. The information on brain differences should be considered in order to treat each student with wisdom of who each student is and to help the student find ways of expression that fit his/her specific brain makeup. They believe true equality of education will occur as teachers take into account the importance of how the brain learns, including differences that may exist between female and male brains.

What We Know About Females and Males

There are no gender differences in overall cognitive ability between females and males (Galambos et al., 2009; Hyde & Lindberg, 2007; Spelke, 2005). Spelke (2005) found that gender differences in math and science cannot be explained by innate differences in cognitive abilities. Hyde and Lindberg (2007) supported this claim by identifying multiple studies that indicated direct training may reduce gender differences.

However, there are recognizable differences in patterns of cognitive abilities. Differences vary by ability and by age (Galambos et al., 2009). They cite adolescents and adults as the most reliable sources of evidence regarding cognitive gender differences. Females are better than males in verbal fluency, writing, perceptual speed, and verbal memory. Males are better than females in spatial and math skills. Marsh (1989) recognized that females may find their confidence to succeed in difficult math courses undermined by parents' and teachers' beliefs that females are weak in math abilities. The same could be said of males regarding their verbal and writing abilities.

Gurian et al (2001) further described cognitive differences between female and male students. Females generally differ from males in communication methods, learning interactions, self-control, and thinking patterns. Females and males approach communication differently. Females rely heavily on verbal communication verbalizing feelings and responses quickly, listening and hearing clearly the concrete details in a conversation, and using everyday words as they learn and communicate. Males rely heavily on nonverbal communication and coded language looking for clear evidence to support the claims of others developing codes among themselves using language from sports trivia, the law, military, or other jargon.

Learning interactions during cooperative learning activities vary between females and males (Gurian et al, 2001). Females form loose groups with sensitivity to the emotions of others. They have a tendency to choose interactive social activities that allow for more verbal communication. Males form structured teams with a focus on goal orientation and production. Pecking order, where a student fits into the social group, is extremely important to males and is determined by physical size, verbal skills,

personality, and abilities. Males typically choose activities that involve movement and physical aggression.

Females and males differ in their practices of self-control and their use of space and movement during the learning process. Females manage boredom differently than males requiring less frequent stimulation from the instructor. Males tend to take up more physical space when they learn. Males use movement frequently to stimulate their brains and to manage impulsive behavior. The lower levels of serotonin in males, discussed in a previous section, may result in fidgeting behaviors. In addition, testosterone spikes may stimulate aggression. Gurian and Stevens (2005) further emphasized the crucial need of males for physical movement to increase their academic success and decrease discipline problems.

Gurian et al (2001) noted differences in memory storage, approach to learning concepts, and abstract processing between females and males. Females store a large quantity of random information for a short period of time and remember sensory data well. Males store a large quantity of trivia for long periods of time if it has specific meaning to them and remember spatial concepts well. Females approach learning from an inductive approach by adding more to the base of conceptualization beginning with concrete examples. Males approach learning from a deductive approach by starting with the general principle and applying it to individual cases. Females prefer written texts when learning abstract concepts. Males prefer symbolic texts, diagrams, and graphs, but may also calculate proficiently without seeing or touching the concept. They enjoy abstract philosophical conundrums and moral debates.

Hyde and Lindberg (2007) expressed concern that some abilities have been stereotyped as gender differentiated when research does not support such differences. They identified effect size (*d*) from numerous meta-analyses. The effect size indicated the magnitude of the gender difference. An effect size of *d* = 0.20 represents a small difference, *d* =0.50 is a moderate difference, and *d* = 0.80 represents a large difference (Cohen, 1988; Shavelson, 1996). Only one academic factor resulted in a large effect size favoring males: mental rotation, *d* = 0.73 (Linn & Petersen, 1985). Seven factors resulted in moderate effect size favoring males: physical aggression, *d* = 0.60 (Hyde, 1984); mental rotation, *d* = 0.56 (Voyer et al., 1995); aggression of all types, *d* = 50 (Hyde, 1984); activity level, *d* = 0.49 (Eaton & Enns, 1986); spatial perception, *d* = 0.44 (Voyer et al., 1995); spatial perception, *d* = 0.44 (Linn & Petersen, 1985); and verbal aggression, d = 0.43 (Hyde, 1984). The following factors resulted in small or negligible effect size for gender differences: science, *d* = 0.32 (Hedges & Nowell, 1995); perceptual speed, d = -0.28 (Hedges & Nowell, 1995); eye-motor coordination, *d* = -0.21 (Thomas & French, 1985); self-esteem, *d* = 0.21 (Kling, Hyde, Showers, & Buswell, 1999); spatial visualization, *d* = 0.19 (Voyer et al., 1995); spatial ability, *d* = 0.19 (Hedges & Nowell, 1995); reaction time, *d* = 0.18 (Thomas & French, 1985; mathematics, *d* = 0.16 (Hedges & Nowell, 1995); confidence in math ability, *d* = 0.15 (Hyde et al., 1990); self-esteem, *d* = 0.14 (Major, Barr, Zubek, & Babey, 1999); verbal ability, *d* = -0.14 (Hyde et al., 1990); math computation, *d* = -0.14 (Hyde et al., 1990); spatial visualization, *d* = 0.13 (Linn & Petersen, 1985); reading comprehension, *d* = -0.09 (Hedges & Nowell, 1995); math problem solving, *d* = 0.08 (Hyde et al., 1990); vocabulary, *d* = 0.06 (Hedges & Nowell, 1995); and math concepts, d = -0.03 (Hyde et al., 1990). Based on these results, Hyde and

Lindberg (2007) recommended offering instruction to students using multiple methods, but not assigning them a specific method based on their gender. In addition, they suggested encouraging students to develop multiple ways of learning to allow them the flexibility to learn in various situations.

Puberty and Adolescence

Gurian et al (2001) identified the difference in maturity between females and males within the ages of 10 and 20 as the most pronounced gap based on brain differences. Puberty and adolescence occur during this time period. Puberty has been described as a brain and neuroendocrine process that stimulates physical changes and psychological changes resulting in reproductive competence (Gurian et al, 2001; Kuhn, 2009; Susman and Dorn, 2009). The process consists of a series of hormone and physical growth changes that form the foundation for the transition from childhood to adolescence. Gonadotropin-releasing hormone is activated which stimulates secretion of gonadotropins (leutinizing hormone and follicle stimulating hormone) and sex steroids (testosterone, progesterone, and estrogen). These changes result in sexual maturation and related physical growth changes. They believe the physical and psychological changes that take place during puberty likely contribute to social, cognitive, and emotional changes that also occur.

Adolescence is a broader concept of time that includes puberty and the social, emotional, and psychological changes that mark the transition from childhood to adulthood (Kuhn, 2009; Susman and Dorn, 2009). Adolescence involves the process of acquiring adult cognition, emotions, and social roles that are possible through brain development and interactions within family, educational, and social contexts (Susman &

Dorn, 2009). Kuhn (2009) identified enormous individual variability in development and cognitive functioning during adolescence.

Individual variation can result in a wide range of developmental characteristics. Susman and Dorn (2009) view adolescence as a transitional period that is not always experienced as a time of storm and stress. Some students may go through adolescence seamlessly; however, others will exhibit more extreme behaviors as described by Gurian et al (2001). They indicated that students are likely to select extreme behaviors to either hide or to bring attention to them. Some extreme behaviors may be pathological to include self-destructive behaviors such as eating disorders, cutting, and other violent behavior. Other extreme behaviors may include simple adjustments that may affect learning like pretending to not know the correct answers, dominating discussions, or exaggerated behavior. They described general characteristics of middle school male adolescents:

> Middle school boys often find themselves in strange moods, angry, aggressive, clumsy and awkward, unable to verbalize feelings, focused on girls but scared of them, competing against boys for the attentions of girls, and relatively unable to verbally discern the complexities of their own developing nature (Gurian et al, 2001, p. 205).

They also described general characteristics of middle school female adolescents:

> Middle school girls are faced with mood swings, vacillation of self-confidence, hyperattention to how they fit into the world of other girls, and competition with other girls for boys' attentions. They are often chagrined at how immature boys are in comparison to themselves; they mask their real selves in order to find

> romance. They are also harassed, quite often by boys, for their breast size, physical growth, weight, or other overt physical characteristics (Gurian et al, 2001, p. 205).

Clearly, the time students spend in middle school is one of significant personal change. In addition to biological and psychological changes, structural changes in school settings occur during the same time period.

Middle Schools

Elmore (2009) described extraordinary variety and an organizational structure that is different from elementary school as characteristics of middle schools. The variety stems from the individual development of students. Students in one classroom could be at various stages of development from well into puberty to not having yet entered it. As a result some students look two or more years older than they are and other students who look two or more years younger than their peers. In addition to physical differences, students also enter middle school with various social skills that are considered appropriate by adults, which leads to a common struggle with the establishment of adult authority. Students consistently test the social rules and classroom routines. Consequently, middle school teachers and administrators identify discipline problems and engagement as major challenges.

Students in middle school typically experience a change in school settings when they progress from elementary school into middle school (Elmore, 2009). The buildings are more complex with a maze of hallways. The presence of adult authority is more obvious, particularly in the form of disciplinary staff. Teachers commonly teach specialized subjects by content area and students move from teacher to teacher. The

interaction between students and teachers begins to revolve around the students' ability to convince the teacher they have mastered academic content. Teachers may have a caseload of 80-140 students which inhibits their abilities to know the multiple aptitudes and competencies of each student. Routine becomes a priority as students' learning is increasingly assessed in terms of assignments completed, results on quizzes and tests, and teachers' judgments of classroom engagement and behavior.

In addition to school setting changes, students in middle school may be introduced to changes in curriculum options that include two or more levels of curriculum based on student ability. Student abilities are based on teachers' and administrators' assessments. Elmore (2009) claims that the most obvious distinctions are made in math, where teachers may have very clear preconceptions about what defines ability and prior knowledge. He suggested that the level of math class students are allowed to take in high school may be determined by the level of math they received as early as fifth grade, which may lead to the beginning of acculturation to school as an institutional structure that allocates status among students and families. Distinctions between students in terms of their levels of academic performance and their ability to secure adult approval become more obvious and consequential in middle school.

Spielhagen (2008c) proposed single-sex classes in middle schools as a way to address the various developmental needs of students. She acknowledged that single-sex classes are not the answer for all challenges, but does suggest that they are beneficial for some students, females and males, in some academic areas. Gurian and Stevens (2005) are convinced single-sex education is a "powerful innovation" for math and science in addition to other subject areas (p. 176). Spielhagen (2008b) pointed out that advocates on

both sides of the single-sex class argument agree that middle schools provide a critical opportunity for the formation of habits that promote academic achievement.

Gurian and Stevens (2005) agreed that middle school was an important time to separate females and males for some classes given the hormonal, developmental, and social challenges that students faced during adolescence. They further suggested that single-sex classes be considered to address academic and behavioral issues that arise in middle school. Gurian et al (2001) predicted that at least half of the learning and discipline problems that occur in middle schools would be avoided if middle schools were single-sex institutions. Gurian and Stevens (2005) reported that many middle schools, consisting of any combination of grades five through eight, offer single-sex classes. Rogers (2008b) identified eighth grade as a landmark year for some studies on single-sex classes.

Mathematics Instruction

Stein (2001) proposed two ways of thinking about mathematical expertise: from a cognitive psychological approach and from a sociocultural approach. Cognitive psychological approaches to learning mathematics argue that students develop better understandings in two ways: by adding to and by reorganizing their internal arrangement of facts, procedures, and concepts. Students may simply add new information when it fits neatly into an already organized arrangement. For example, second graders are exposed to the hundreds place for the first time and organize it into their current understanding of place value. On the other hand, they reorganize within their existing arrangement when new information differs from their existing arrangement. For example, students who believe multiplication always produces larger numbers will need to

reorganize their understanding of the concept of multiplication when they encounter fractions. Generally, reorganizations are much more difficult and anxiety provoking than are simple additions to one's internal arrangements. However, reorganizations produce new insights into the structure of mathematics that make the struggle worthwhile.

Stein (2001) described the sociocultural approach of learning mathematics as the participation in the social practice of mathematics in which students develop the intellectual tools required to think and reason mathematically through the process of discussion and debate. This approach views math as a way of experiencing the world in which students live as opposed to a fixed set of knowledge to be acquired. Ideally, the mathematically skilled students understand the rules by which mathematic principles are made and apply those rules in appropriate ways when discussing and using mathematics. Classroom communication that is designed and carried out by jointly established norms is an essential characteristic of classrooms that support students' learning in this way.

The acquisition of mathematics knowledge and skills has been identified as a critical filter to higher level math programs (Hyde, Fennema, & Lamon, 1990; Shapka & Keating, 2003). This filter often diverts students from math-related career pathways by preventing them access to post-secondary programs that require advanced math instruction. For example, engineering requires problem solving skills that involve advanced math applications.

There has been a focus on the gap in math achievement between females and males over the years. Most single-sex classroom research has examined classroom inequities and female participation in math (Mael, 1998). Hyde, Fennema, and Lamon, (1990) found there were no differences between females and males in problem solving

within elementary or middle schools. The differences favoring males arose at the high school and college levels. Fennema (1980) contributed differences at these levels to differential course-taking. She elaborated by stating males have usually preferred to pursue more math classes than have females. As a result, a more mathematically educated group of males has been compared to a less mathematically educated group of females. She indicated when the amount of courses taken is controlled, few sex-related differences in achievement are found. Gurian et al (2001) presented more recent accounts of math differences. They indicated that the females have caught up to the males in math scores and that females take more math classes than males.

On the other hand, Gurian et al (2001) offered a contrarian viewpoint when referencing the highest levels of math. They explained that the configuration of the male brain favoring high abstraction and design would probably always give males a statistical advantage over females at the highest levels of math. Hyde et al (1990) suggested looking at internalized belief systems about math, sex discrimination, and math curriculum at the pre-college level to understand the lesser presence of women in post-secondary math courses and math-related occupations.

Gurian and Stevens (2005) proposed an ultimate goal of turning all students' worlds into laboratories of learning where they consider math so essential and relevant that they become mathematicians throughout their lifetime. Considering math expertise as a practice requires a shift in thinking about learning math from something that occurs within the minds of students to something that happens within the interactions among students and between students and teachers (Stein, 2001). Fennema (1980) identified teachers as the most important educational influence on students' learning of math.

Stein (2001) claimed the selection of instructional strategies as the most important decision a teacher makes. In mathematics, the instructional strategies determine what content students have the opportunity to learn which influences their perceptions of what mathematics is. One of the beliefs of mathematics reform is that students should be engaged in fewer tasks related to important mathematics as opposed to many tasks related to trivial mathematics.

Instructional strategies related to effective mathematics instruction incorporate problems that allow for multiple representations and the use of manipulatives (Stein, 2001). He suggested that effective mathematics instruction should incorporate problems that can be solved in multiple ways to increase flexible thought processes about mathematical ideas, settings, and methods. Students develop skills and confidence as mathematical problems solvers as they create and apply their own procedures to problems that have multiple solutions. Their created procedures are connected to their conceptual understandings and personal meanings as opposed to a set of external procedures without relevance that they memorize and apply. He also suggested that effective mathematics instruction emphasize the use of manipulatives, diagrams, sketches, and oral language to describe and make personal meaning out of quantitative situations. Students are more likely to become proficient in the use of mathematical symbols, definitions, and procedures when they have the opportunity to use manipulatives, diagrams, and oral language as they relate to a problem (Stein, 2001).

Theory of Instruction

Gagné (1985) proposed a theory of instruction consisting of instructional events that promoted internal learning processes. He combined categories of learning outcomes

and events of learning within an information-processing model to develop the theory of instruction. He defined learning as a "change in human disposition or capability that persists over a period of time and is not simply ascribable to processes of growth" (p. 2). His theory of learning includes internal conditions which include previously learned capabilities and external conditions which include various instructional events. Information-processing models of learning provided the foundation for his theory.

Information-processing models were developed from three fields of research: mathematics, computer science, and linguistic science (Gagné, 1985). Learning psychologists were interested in formulating a mathematical learning theory that represented the variables of the learning process involved in solving mathematical equations. Computer scientists were interested in determining the limits of intellectual processing of newly developed computers. Linguistic scientists were interested in how human beings learn and process language. The combined research of these attempts generated the information-processing theory that Gagné (1985) relied on to develop his learning theory.

Gagné (1985) provided a detailed account of the flow of information as it is processed according to the information-processing model:

> Stimulation from the learner's environment activates receptors to produce patterns of neural impulses. These patterns persist in the sensory register for a brief interval (some hundredths of a second), from which they may be processed by selective perception into perceived objects and object-qualities, or features. This "information" may then be stored in short-term memory as auditory, articulatory, or visual images, which are subject to

> rehearsal. As input to the long-term memory, the formation is semantically (or meaningfully) encoded, and then stored in this form. Processes of search may be instituted, followed by the process of retrieval. At this point, the information may be returned to the short-term memory, which is conceived as a "working" or "conscious" memory. From this structure, or directly from long-term memory, the response generator is brought into play to generate a suitable response organization. The signal flow from this structure activates effectors which exhibit the human performance. Feedback is provided via the learner's observations of this performance, and the phenomenon of reinforcement establishes the learned entities as capabilities available for future recall, exercise, and use (p. 75-77).

In addition, executive control processes may affect any point or points along the information flow. Executive control processes influence attention and selective perception by determining what contents within the sensory register will be entered into the short-term memory, deciding what is retained in the long-term memory, searching and retrieving information, choosing how to respond, and determining strategies for problem-solving and generalizing. Expectancies are a type of executive control process that represents the motivation of students to reach the goal of learning.

Gagné (1985) identified five types of learning outcomes that he referred to as "varieties of learned capabilities" (p. 47): intellectual skills, verbal information, cognitive strategies, motor skills, and attitudes. Intellectual skills include procedural knowledge that gives students the capability to understand and apply the use of symbols. Symbols are used to interact with the environment. The content of mathematics requires

intellectual skills almost exclusively. Verbal information consists of the capability to state ideas by using oral speech, writing, typing, or drawing a picture. Cognitive strategies control the learners' internal process and enable students to manage their own learning, thinking, and remembering. Motor skills involve executing movements to accomplish a physical task. Attitudes encompass the mental states that influence the choices of personal actions.

Gagné (1985) listed internal conditions and external conditions for learning intellectual skills. Internal conditions included previously learned skills that represent components of the new skill and the processes that will be used to recall them and put them together in a new arrangement. External conditions included stimulating recall of the subordinate skills, informing the student of the performance objectives, guiding the new learning by a statement or question, and providing an opportunity to perform the newly learned skill in connection with a new example.

Instructional Events and Strategies

Instructional events are external processes that support internal processes of learning based on information-processing theory of learning (Gagné, 1985; Gagné & Medsker, 1996). Such events include gaining attention, informing students of the objective, stimulating recall of prior learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, enhancing retention and transfer. Instructional strategies have been defined as determining the sequence of instruction for each objective and designing the teaching practices to be utilized (Briggs, 1977). Gagné and Medsker (1996) provided some examples of strategies for accomplishing each instructional event (See Table 2.1).

Table 2.1

Instructional Events and Strategies

Events	Strategies
Gaining Attention	Gestures
	Voice Tone/Volume Alterations
	Audio-Visual Experiences
	Unusual Events
Informing Learners of the Objective	Verbal Statements
	Examples
	Demonstrations
Recall of Prior Learning	Pre-Requisite Rules/Concepts
	Previous Knowledge
	Related Situations/Actions
	Individual Steps of a Task
Presenting the Content	Verbal Explanation/Description
	Demonstration
	Variety of Examples
	Emphasis on Distinctive Features
	Emphasis on Rule Application
Providing Learning Guidance	Variety of Examples and Non-Examples
	Demonstrate or Apply Rules in a Variety of Contexts

Table 2.1 *(continued)*.

Instructional Events and Strategies

Events	Strategies
Eliciting Performance	Student Demonstration
	Fading Cues
	Progression of Quality Standards
	Progression of Quantity Standards
	Advancement of Difficulty Levels
	Backward Chaining
Providing Feedback	Degree of Correctness
	Degree of Incorrectness
	Corrective Feedback
Assessing Performance	Formal Assessment
	Informal Assessment
Enhancing Retention and Transfer	Repeated Practice
	Practice Variety

Note. Instructional events are from Gagné (1985). Strategies are from examples of "instructional techniques" provided in Gagné & Medsker (1996).

Gagné (1985) pointed out that all instructional events may not be present in every learning situation and that as students become mature learners, they develop learning strategies that enable them to practice "self-instruction" (p. 256).

Gaining attention occurs when instructors introduce rapid changes in stimulus that supports the internal process of stimulus reception (Gagné, 1985; Gagné & Medsker, 1996). Strategies for gaining attention may involve gesturing or altering the volume or tone of their voice or other sensory changes. Instructors may incorporate transparencies, audio-visual experiences, or unusual events to gain attention. Matching the content of the attention gaining experience with the content to be learned facilitates "lesson coherence" (p. 140, Gagné & Medsker, 1996).

Informing learners of the objective supports the internal process of expectancy (Gagné, 1985; Gagné & Medsker, 1996). Expectancy represents the motivation students may have to obtain an objective that has been set before them. Gagné & Medsker (1996) provided examples of instructional strategies instructors may use to inform students of the learning objectives. Instructors may verbalize the objective, show an example of the objective, or demonstrate the objective to be accomplished.

Stimulating recall of prior learning supports the internal process of retrieval to working memory (Gagné, 1985; Gagné & Medsker, 1996). The best type of learning to be recalled should be related somehow to the new concept. Gagné & Medsker (1996) provided examples of instructional strategies instructors may use to stimulate recall of prior learning. Instructors may recall pre-requisite rules or concepts, well-organized bodies of knowledge related to content, situations and actions related to content, or individual steps of a task.

Presenting the content supports the internal process of selective perception (Gagné, 1985; Gagné & Medsker, 1996) and involves strategies used to present new information related to the objective to be learned. Gagné & Medsker (1996) provided

some examples of instructional strategies instructors may use to present the content. Instructors may provide a verbal explanation or description of the new concept, conduct a demonstration, or show a variety of examples. Gagné & Medsker (1996) recommended emphasis be placed on distinctive features of the new concept or distinctive aspects of rule application. They also identified illustrated lecture, text and pictures, and guided discovery as delivery methods for presenting the content.

Providing learning guidance supports the internal process of semantic encoding into long-term memory storage (Gagné, 1985; Gagné & Medsker, 1996) and may involve providing concrete examples or elaborating to increase the worth of the new concept to the students. Gagné & Medsker (1996) provided examples of instructional strategies instructors may use to provide learning guidance to include a variety of examples and non-examples of the new concept. They recommended instructors state rules verbally, then demonstrate or apply the new concept in a variety of contexts.

Eliciting performance supports the internal process of responding (Gagné, 1985; Gagné & Medsker, 1996). Eliciting performance provides the student the opportunity to demonstrate knowledge of the new skill and to practice. The student may perform the desired skill or a modified version of the desired skill until the final performance is requested by the instructor. Gagné & Medsker (1996) provided four examples of strategies used to modify a desired skill. One, referred to as "fading" (p. 148), involves providing many cues or written directions at the beginning of the practice session and gradually decreasing cues or directions throughout the practice session. A second strategy is to add quality or quantity standards gradually to the practice session, while a third strategy is to increase gradually the difficulty level of the practice session. A final

strategy is to allow students to work a problem using procedural steps in reverse order, called “backward chaining” (p. 148).

Providing feedback supports the internal process of reinforcement by giving the students information about their performance (Gagné, 1985; Gagné & Medsker, 1996). Students may be aware that they are unsuccessful, but may not understand what they need to do differently to improve. Corrective feedback by the instructor may be required to assist the student in understanding how to improve performance.

Assessing performance supports the internal processes of retrieval and reinforcement and is usually in the form of a test or other technique (Gagné, 1985; Gagné & Medsker, 1996). The functions of assessing performance include verifying that the objective has been learned at a level of proficiency and providing additional practice to reinforce what has been learned. The student should be able to perform without assistance to a preset standard of quality or quantity. Assessments may be formal or informal in format.

Enhancing retention and transfer supports the internal processes of retrieval and generalization (Gagné, 1985; Gagné & Medsker, 1996). This instructional event involves repeated practice of the new concept even after assessment has occurred. In addition, practice variety facilitates transfer of the learned concept to various situations.

Gagné (1985) acknowledged assumptions made regarding additional conditions that affect instruction. These conditions included time, motivation, and individual differences. It is assumed that the amount of time students spend learning a concept will have a direct relationship to their level of proficiency. Secondly, it is assumed that the students will have a favorable level of motivation to learn. Finally, it is assumed that each

instructional event will have the same type of effect on the internal processes of each student and that the primary individual differences may be due to processing time.

Gagné's (1985) theory of instruction was further developed by Gagné and Medsker (1996). There were minor semantic changes made to the theory. For example, the instructional event "presenting the stimulus" (p. 246, Gagné, 1985) was changed to "presenting the content" (p. 140, Gagné & Medsker, 1996). In addition, Gagné and Medsker (1996) discussed behavioral approaches to training in greater depth in the segment describing eliciting performance. They stressed that modified versions of the final performance may be appropriate for a time before the final performance is expected. Finally, more definitions were added to the supportive content to further uphold the theory. For example, Gagné and Medsker (1996) included specific definitions for retention and transfer. Retention was defined as "the ability to reproduce learned behavior after a period of time has elapsed since the last performance" (p. 149). Transfer was defined as "the ability to use the learned skill in a slightly different (or greatly different) situation than the ones in which it was learned" (p. 149). There were no significant changes to Gagné's (1985) theory of instruction.

Varieties of Instructional Strategies

A variety of instructional strategies is described by others that may also be used to accomplish the instructional events described by Gagné (1985). Moore (2009) described direct teaching as an instructor-centered model in which the instructor is the primary source of information for the students. It is an efficient and effective way to provide students with fundamental information. However, it is not effective in teaching higher

level thinking skills such as analysis or evaluation. Examples of direct teaching include lecture and questioning.

On the other hand, Moore (2009) described indirect teaching as a student-centered method that allows students to take more active roles in learning. The instructor presents students with materials and opportunities to generate their own connections and generalizations. This method is effective in developing higher level thinking skills. Examples of indirect teaching include discussion and problem solving. Schraw and Reynolds (2009) referred to this strategy as socially-mediated learning.

Autonomous learning provides students the opportunity to actively reflect on new ways to apply knowledge. Journaling and computer-assisted instruction involves various levels of autonomous learning. Schraw and Reynolds (2009) advocate the use of strategies associated with all three models for most effective instruction. The art of questioning is involved in all three instructional strategies.

Use of Video-Recording in the Classroom

Teaching and learning are complex activities that are isolated and private which limits instructors in their opportunities to view and discuss instructional strategies. Because of the rapidly changing and complex nature of the classroom, Seago (2004) recommended the use of video when studying classrooms. He asserts video-recording is more accessible and affordable than ever resulting from technological advances which make it a feasible research tool. Brophy (2004) added that sufficient video and audio clarity allows observers to view instructional strategies as they occur almost as if they were present in the classroom. Video-recorded data may contribute to “powerful

investigations of teaching and learning" when combined with other data formats" (p. 23, Sherin, 2004).

Advantages and disadvantages are associated with the use of video-recorded data during educational research. The most prevalent advantage is it provides a record of data that may be analyzed multiple times from various perspectives (Nastasi, 2009; Roschelle, 2000; Seago, 2004; Sherin, 2004). In addition, it is useful for conducting member checks with participants to ensure appropriate interpretations are made. The primary disadvantage is the amount of time and effort involved in recording, transcribing, and coding video-recorded data (Nastasi, 2009).

Brophy (2004) stressed the importance of obtaining necessary permission before video-recording begins. In addition, he recommended one or more visits to the classroom to conduct preliminary video-recording. Preliminary visits allow the researcher to become familiar with recording equipment and spatial arrangements. Furthermore, the instructor and students may become more comfortable with the cameras, microphones, and researcher during the preliminary visits.

Seago (2004) emphasized that video is limited as a tool and that its use will determine what is observed and therefore what is learned. Brophy (2004) pointed out that cameras and microphones play similar roles to that of visitors to the classroom who observe events as they happen without participating in them. The use of high quality digital video equipment ensures good resolution resulting from vivid color and dramatic contrast and allows for manageable editing and copying (Bliss & Reynolds, 2004; & Roschelle, 2000).

Video sound and camera angles are critical in obtaining informative data. In addition, wide-angle views should be used to provide a general orientation to the classroom (Brophy, 2004). He recommended the use of two camcorders to capture instructor and student actions allowing the observance of teaching and learning simultaneously. Similarly, Roschelle (2000) recommended stationary cameras be secured on tripods to avoid quick movements that are difficult to watch. He suggested recording just before participants enter the room until after they leave. In addition, he emphasized the importance of imprinting the date and time including hours, minutes, and seconds. Finally, lapel microphones are useful in capturing interactions that occur in small groups (Brophy, 2004; Roschelle 2000; & Sherin, 2004).

The final product should be edited to tell a story which includes essential elements that are retained in their original sequence yet removing non-essential elements (Brophy, 2004). He recommended titles to include grade level, subject matter, and the teaching or learning aspect that is viewed within the video segment with deletions signaled to the viewers by going black briefly or by inserting commentary about what occurred between segments. Finally, information about the instructors, students, curriculum, and activities should be included within the video or supporting materials.

Summary

The literature is broad as it relates to the study of single-sex and coeducational math classrooms within a public middle school. The historical context of single-sex education in the United States and recent legislative changes have affected the implementation of single-sex classrooms within coeducational public schools.

Inconclusive research results and conflicting views of single-sex classes promote controversy that is fueled by political and social implications. Strong debates between proponents and opponents of single-sex classes are occurring just as they did many years ago. As a result, there is a need for studying and reporting on single-sex issues to determine what instructional strategies are effective for all students. There is still much support for the coeducation system that has been in place for so many years, but there is an increasing number of schools that are implementing single-sex classes within coeducational schools.

The controversy surrounding single-sex classroom options may stem from differences and similarities between the sexes as well as the legislative changes. Current brain and neuroendocrine research has identified specific differences in brain structure and hormonal levels between males and females. These variations result in different patterns of development. Students entering middle school experience developmental changes as well as institutional changes as they move from an elementary structure to the secondary structure. Research shows that males are more equipped for spatial and math skills and females are more equipped for verbal, writing, and perceptual skills. This may explain the gap in math achievement between females and males that was reported. Differentiated instruction in math classes may benefit both males and females.

Gagné's (1985) theory of instruction provided the lens for analyzing instructional events and strategies that occurred in the single-sex and coeducational classrooms. Instructional events are external processes that support internal processes of learning based on information-processing theory of learning (Gagné, 1985; Gagné & Medsker, 1996). Such events include gaining attention, informing students of the objective,

stimulating recall of prior learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, enhancing retention and transfer. Gagné and Medsker (1996) provided examples of strategies for accomplishing each instructional event (See Table 2.1).

Video-recording equipment was used as a research tool throughout the study. It was determined the advantages of using video-recorded data during the study far outweighed any disadvantages. The most prevalent advantage is it provides a record of data that may be analyzed multiple times from various perspectives (Nastasi, 2009; Roschelle, 2000; Seago, 2004; Sherin, 2004). In addition, it is useful for conducting member checks with participants to ensure appropriate interpretations are made. The primary disadvantage is the amount of time and effort involved in recording, transcribing, and coding video-recorded data (Nastasi, 2009).

CHAPTER III

METHODOLOGY

The methodology section includes an overview of the qualitative approach to this collective case study given the purpose was to gain a better understanding of the instructional events and strategies in classrooms where the instructors teach both single-sex classes and coeducational classes of math within a public middle school. Ethical considerations are included along with a purpose statement and research questions. The collective case study was conducted in a suburban public middle school that offers single-sex pre-Algebra options to students in the eighth grade. Two instructors who taught both single-sex and coeducational classes were the primary participants. The building principal and school counselors were also available to provide information throughout the study. Data collection involved classroom observations, audio-taped interviews, video-recorded observations, and artifacts. All data identifying individuals were stored securely throughout the study and destroyed completely following the dissertation defense. Pseudonyms were given to all participants involved with the study. Data were analyzed through Gagné's (1985) theory of instruction. Final results were submitted for publication following approval by the dissertation committee.

The selection of methodology and procedures was determined by the type of study to be conducted. Stake (1995) described the defining characteristics of a qualitative

study as the theoretical perspective of the case study. One characteristic, the holistic nature of the study, emphasized the importance of the whole case and the interdependence of its parts. The study was case-oriented and bound by the case. Another characteristic, empirical focus of the study, emphasized naturalistic observations within the field of the case including observations by participants. In addition, the study was interpretive and the researcher relied on intuition more than specific pre-defined criteria. The researcher worked to keep attention free to recognize events relevant to the research question. Finally, the study was empathic and sought to understand the participants' frame of reference and value commitments. The design is emergent and responsive throughout the study.

Case study was the strategy of inquiry. Stake (1995) compared the purpose of instrumental case study and the collective case study with the former being to understand and seek insight into a question by studying a particular case, while the latter includes the study of several individual cases that are coordinated to gain a broader understanding of the research question. This study employed the collective case study strategy of inquiry because several individual classrooms were studied to gain a better understanding of instructional events and strategies employed by teachers who taught both single-sex and coeducational classes.

Methods of data collection and analysis included essential components identified by Stake (1995). The cases within the study were defined as the classrooms of two instructors, Mrs. Davis and Mrs. Moore, who taught both single-sex and coeducational pre-Algebra classes. Individuals willing to assist with the study were the building principal, the school's two counselors, and a video design teacher for technical support

related to video-recording. The principal identified teachers who were teaching single-sex classes and coeducational classes. Two math teachers, Mrs. Davis and Mrs. Moore, were invited to participate in the case study because their pre-Algebra classes were expected to provide the richest data due to the relative similarity in size and timing of the single-sex and coeducational classes. Additionally, data received during the planning phases of the research study reflected insufficient enrollment in the single-sex science class; as a result, the single-sex and coeducational science classes were not included in this study.

Time allocation for the study included eight hours of classroom observations, four hours of interviews, 16 hours of video-recorded observations to include a minimum of three video-recorded class periods in each of the four classes, and time for artifact review and data analysis. Reporting was shared with the teachers participating in the study and the building principal following the analysis of all video records.

Ethical Considerations

Ethical protocols established by Oklahoma State University (OSU) Human Subjects Protection Program and the Institutional Review Board (IRB) were followed. In addition, the researcher requested permission to conduct this research from the district administrative office and from the building principal at Bedford Middle School (BMS). Pseudonyms were given to all participants involved with the study.

The OSU Human Subjects Protection Program included three basic protections: respect for persons, beneficence, and justice. Respect for persons refers to informed consent, privacy, and confidentiality. Beneficence includes scientific merit and the balance of risk and benefits to participants. Justice refers to a review of participant selection to ensure equal distribution of the risks and benefits of participation. OSU

requires all research involving human subjects be submitted to the OSU IRB before the research study begins.

A formal application process for conducting research within the Bedford School District (BSD) did not exist; however, a prospectus of this research study, a tentative timeline for data collection, and samples of consent forms were delivered to the superintendent of BSD February 25, 2010 with a formal letter requesting permission to conduct the study at BMS. A letter of approval from the superintendent was received February 26, 2010. In addition, a prospectus of this research study, a tentative timeline for data collection, and samples of consent forms were sent to the BMS principal February 25, 2010 with a formal letter requesting permission to conduct the study within BMS on. A letter of approval from the principal was received March 1, 2010.

The events of the initial visit took place March 9, 2010 after the study had been approved by the dissertation committee, the OSU IRB, the superintendent, and the building principal. During the initial visit a detailed plan of action was discussed with the building principal and arrangements for regular access was established. The instructors were formally invited to participate in the study and all participants were provided with informed consent documents. There was a formal discussion about confidentiality related to participants and data along with a discussion about the need for participants to validate observations and descriptions made by the researcher.

Parental approval was requested March 10, 2010 through mailing a parent permission letter, parent permission form, self-addressed stamped envelope, and a coupon valued at no more than $2.00 to a local restaurant to the mailing address of 85 students. Parents were asked to send the completed parent permission form to the

researcher using the enclosed self-addressed stamped envelope. Parents of 54 students were contacted March 22, 2010 to confirm accurate address data. An additional mailing was delivered as needed. Ninety-two percent of the parents returned a signed parent permission form granting approval: 100% of 18 parents of students from the single-sex female class, 92% or 22 out of 24 parents of students from a coeducational class, 91% or 19 out of 21 parents of students from the single-sex male class, and 86% or 19 out of 22 parents of students from a coeducational class. A second phone call was made April 1, 2010 to 13 parents who had not responded: six parents requested an additional permission form, messages were left with three parents, and four parents did not answer. None of the parents expressed disapproval of the study and no permission forms were received denying approval. One parent requested a copy of the results.

Students were invited to participate after their parents were informed of the study. The researcher invited students to participate by using the invitation script and distributing the assent form during class. Students in Mrs. Davis' classes were invited March 23, 2010 to participate. The first class of students, a male only class, was reasonably talkative and respectful. Four students asked questions about the study and what I was looking for. Each of the students raised his hand and waited to be selected. One student expressed a concern for the researcher and the study because he said "they may act differently with cameras in the room." He was assured that there would be more than one day of video-recording. Another student was unsure about signing the assent form without talking to his parents. He was shown the signed permission form his parents had returned and was encouraged to visit with his parents and ask any questions he had.

In the second class of students, a coeducational class, the students appeared to be engaged by eye contact and non-verbal body language cues. None of the students asked questions.

Mrs. Davis informed the researcher that she had overheard students talking about seeing the envelopes containing the permission forms and taking them before their parents saw them. Some of them reportedly said they saw the coupon inside the envelope and realized it was nothing bad. The envelopes were plain white and the mailing labels were black and white. The only source of recognition was the information on the address label that was printed from the school database. It was addressed to "The parents/guardians of" followed by the student's name. This may explain why parents of 54 students were initially contacted to verify accurate address data.

Students in Mrs. Moore's classes were invited to participate March 24, 2010. The first class was a coeducational class. These students were relatively engaged, but they asked no questions. In the second class, a single-sex female class, students asked questions primarily related to the video-recording. One girl asked, "Who will see the video?" She was assured only the researcher, her instructor, and those involved in the research process would see the video. Another one asked, "What should we do if we don't want to be on camera on a certain day?" It was explained that the focus of the study was on instructional events and strategies which meant there will be more focus on the teacher than on the students.

Research Questions

1. What instructional events are incorporated in single-sex and coeducational classes?
    a. What instructional events are incorporated in single-sex classes?
    b. What instructional events are incorporated in coeducational classes?

2. What instructional strategies do instructors who teach both single-sex and coeducational math classes use in the respective classrooms?
    a. What instructional strategies are used in single-sex classes?
    b. What instructional strategies are used in coeducational classes?
3. What are challenges of the single-sex and coeducational classes?
    a. What are the challenges of the single-sex classes?
    b. What are the challenges of the coeducational classes?
4. How does the theoretical framework inform or explain the process?
5. What realities discovered in the study were not explained by the theoretical framework?

Setting

BPS, located in a suburban community of 39,000, is in the northeast quadrant of Oklahoma. Residents are employed in professional, business, and skilled labor occupations, and the estimated median household income in 2007 was $58,647 while the estimated median household income for Oklahoma was $41,567. A recent (2008) cost of living index in Bedford was 83.0, which was below the U.S. average of 100. The median resident age was 31.7 in 2007 compared to the state median resident age of 35.5. Over 51% of the population was female (City-Data, n.d.).

BMS's mission is to create well rounded individuals, by educating mind and body in a positive atmosphere that maximizes individual potential. BMS, established in 1995 at the site of the former junior high school, had 45 certified faculty and staff, and a current enrollment of 664 eighth grade students. The school's ethnic composition was 67.6% Caucasian, 17.6% Native American, 9.2% Hispanic, 2.4% African American, 2.4%

Asian, and less than 1% of Pacific Islander and Middle Eastern students. The school calendar, comprising two 18 week semesters, was 180 days long. Six 55 minute periods comprise the daily schedule, allowing students to enroll in four core classes and two electives. The school offered a wide variety of student organizations and activities. All students were required to take the *EXPLORE Test* in September, *Oklahoma Writing Test* in February and the *Oklahoma State Criterion Reference Test* in April (Bedford Public Schools, n.d.).

BMS was the only school within 570 square miles to establish both single-sex and coeducational math classes taught by the same teacher. The single-sex pre-Algebra classes established during the 2007-2008 school year were in their third year of implementation.

Participants

The following individuals at BMS were invited to participate in the study: two classroom instructors, the building principal, a school counselor, and students who were currently enrolled in the single-sex or coeducational classes being observed. Both instructors taught single-sex and coeducational eighth grade pre-Algebra classes. Positive relations were established with the building principal and the school counselor, and they expressed a willingness to participate. Students were observed only in the classroom; they were not questioned or interviewed by the researcher. Purposive sampling was used to select the most informed participants.

Mrs. Moore, a female instructor, taught two female sections of pre-Algebra and one coed section. The female sections were held third hour, 10:00-10:55 am, with 18 students enrolled and sixth hour, 1:30-2:20 pm, with 27 students enrolled. The coed

section met first hour, 8:00-8:55 am, and had 24 students enrolled. This instructor also taught two sections of Algebra I and had one planning period during the school day.

Mrs. Davis, a female instructor, taught one male section of pre-Algebra and four coed sections of pre-Algebra. The male section met first hour, 8:00-8:55 am, with 21 students enrolled. The coed sections were held second hour, 9:00-9:55 am, with 22 students enrolled; fourth hour, 11:30-12:25 pm, with 29 students enrolled; fifth hour, 12:30-1:25 pm, with 27 students enrolled; and sixth hour, 1:30-2:20 pm, with 26 students enrolled. She had one planning period during the school day.

BMS' principal, a female, worked closely with the counselors to implement the single-sex classes. She had 19 years of experience in education. Before becoming a principal, she taught English, was a school counselor, and worked as an assistant principal.

There were two full-time school counselors at BMS. One, a female, was invited to participate because she played a key role in implementing single-sex classrooms in BMS by reviewing research on the subject. She had 27 years of experience in education. The other counselor, a male, was not included in the study. He played a role in maintaining the integrity of the single-sex classrooms by ensuring students and parents were informed of their enrollment options. He had previous experience as an assistant principal and a teacher with a total of 35 years of experience in education.

The eighth grade students enrolled in the classes studied played a secondary role. Their interactions and movements were captured in the video-recorded data. Thus, they were asked to complete assent forms and their parents or guardians were asked to

complete consent forms. However, the students were not questioned or interviewed during the study.

Instruments

The researcher is viewed as the primary data collection instrument as a result of the interpersonal qualities of qualitative research (Nastasi, 2009). Acheson and Gall (1997) identified a number of wide-lens observational techniques that were used to obtain data about instructional events, instructional strategies, and classroom contexts. These techniques made few assumptions prior to the observation regarding what instruction was effective or not effective in each classroom observed. In addition, they enabled the researcher to obtain much information about the classroom in a short period of time. Specifically, field notes written during classroom observations and video-recorded observations were used to obtain raw data.

Two observations in each classroom occurred using the observation techniques recommended by Acheson and Gall (1997) and the video preview log. Each observation included 55 minutes. The instructors at BMS were asked to complete the same video preview log in addition to the video reflection log after viewing the video data. (See Appendices A and B.)

Data Collection

Nastasi (2009) identified utility and adaptability as key factors in data collection methods. Data were collected from the following sources: classroom observations, video-recorded observations, audio-taped interviews, and artifacts. Data collection occurred during the spring semester of the 2009-2010 school year.

Wide-lens observation techniques described by Acheson and Gall (1997) were used during the classroom observations to create field notes. Mrs. Davis' classrooms were observed during first and second hours April 1 and April 5, 2010. Mrs. Moore's classrooms were observed during first and third hours March 30 and April 8, 2010. The focus of the observations was on the instructional events and strategies that were incorporated into the lesson. However, the context of the lesson was also noted such as sounds, images, and other sensory stimuli within the classroom. Stake (1995) recommended observing the ordinary activities of cases with minimal intrusion. Naturalistic observations provide opportunities to document occurrences within real-life settings where the focus is on behaviors, interactions, activities, and contextual features such as spatial arrangements, equipment, lighting, sounds, etc. (Nastasi, 2009). Naturalistic observations were documented in the form of field notes during the two sessions in each of the four classes resulting in eight hours of observation. Nastasi (2009) defined field notes as detailed informal spontaneous records of observations and conversations. Field notes were transcribed within 24 hours of the observation.

Video-recording is another wide-lens observation technique recommended by Acheson and Gall (1997). Video-recorded data may provide in-depth documentation that is particularly useful for capturing the unexpected and complicated events that occur in a classroom (Nastasi, 2009). It also allows subtle and non-verbal interactions to be observed that may not be evident otherwise (Brophy, 2004). Video-recorded data collection began after an initial test of the equipment and camera arrangements to allow participants the opportunity to get used to the video-recording aspect of the recorded observations. There were 20 hours of video-recorded data including a minimum of three

class periods in each of the four classes. Mrs. Moore's classes were video-recorded during first and third hours April 9-15, 2010. Practice video-recording took place Friday, April 9. Official video-recording occurred on Monday, Tuesday, and Wednesday. The video-recording on Thursday served as additional data in the event of technical difficulties on any of the three previous days. Mrs. Davis' classes were video-recorded during first and second hours May 10-14, 2010. Monday, May 10, served as a day of practice video-recording. Official video-recording took place Tuesday, Wednesday, and Thursday. The video-recording Friday served as additional data in the event of technical difficulties on any of the three previous days.

Video-recorded data were transcribed by the researcher and the video-recordings were shared with the classroom instructors after data collection was complete. Sherin (2004) found that teachers are motivated by watching video-recordings of classroom instruction, and that video-recordings are useful for teacher development. The instructors were asked to clarify the information in the transcripts. In addition, they were asked to complete a video preview log before each video-recording and a video reflection log after viewing the video-recording.

A certified instructor within the BSD was identified as a video design expert who agreed to manage the video-recording and editing aspect of the research project. The video-recording aspect involved adequate setup of equipment to ensure quality video and sound as suggested by Brophy (2004) and Roschelle (2000). Participants were informed two to six weeks before the video-recording began. The video-recording was planned to work within the instructors' schedules so as not to create any unnatural changes. Mrs. Moore's classes were video-recorded before state testing began. Mrs. Davis' classes were

video-recorded after state testing ended. One video camera was used at an angle to capture the instructional events and strategies implemented by the instructor. The use of one video camera provided the opportunity to avoid viewing students whose parents did not return the permission form. Camera positioning was determined by the location of those students so as not to require a change in their seating arrangement. In addition, the video design instructor allowed the use of his personal external microphone that was more compatible with one video camera. Video editing involved converting data from videotape to compact disc. Video editing occurred at Bedford High School. All video-recorded data were stored on compact disc with none saved to any computer hard drive.

Interview data included one interview session with each of the two instructors, the principal, and a counselor totaling four sessions. (See Appendix C for interview questions.) The in-depth interview format, as described by Nastasi (2009), is a semi-structured process guided by the research questions. She ranks in-depth interviews as one of the primary methods for collecting data. Each interview was 39-70 minutes in length and was held in a location convenient for the participant. The interview with the principal took place March 11, 2010 from 5:27-6:06 pm, 39 minutes. The interview with the counselor occurred March 31, 2010 from 8:13-9:05 am, 52 minutes. Mrs. Moore's interview took place May 6, 2010 from 12:43-1:50 pm, 67 minutes. Mrs. Davis' interview occurred May 25, 2010 from 10:35-11:45 am, 70 minutes. Three interviews were audio-recorded and transcribed within 24 hours, while the fourth interview was audio-recorded and transcribed within 48 hours. Participants were asked to clarify the information in the transcripts in a process that Stake (1995) called "member tracking" (p.

115). In this process, the participant was asked to review the rough drafts for accuracy and palatability.

Artifacts were gathered to inform the study further. Nastasi (2009) defined artifacts as permanent products of a culture that may include documents, manuals, records, media materials, and other products that reflect the beliefs, norms, and values. She encouraged the use of logs and journals for reflection and self-evaluation as a component of data collection. Artifacts received included a map of the school, still photographs of the two empty classrooms, syllabi, a master schedule, NCLB annual report card for the 2006-2007, 2007-2008, and 2008-2009 school years, enrollment data for the four classes included in the study, pre-enrollment packets for the 2009-2010 and 2007-2008 school years, pre-enrollment presentation for parents, student work samples, video preview logs, and video reflection logs.

Data Storage and Elimination

All transcriptions and field notes were dated and stored separately in chronological order. There was no identifying information within the transcripts or field notes. Hard copies of transcriptions and field notes were stored in the researcher's personal file cabinet. Electronic copies were stored on the researcher's personal laptop computer and on one flash drive stored in the researcher's personal fire-safe vault. Only the researcher had access.

Original video-recordings remain unedited. Edited versions for data analysis included a conversion from videotape to compact disc. A copy of the video-recording was given to the instructor for each classroom to be viewed before completing the video reflection log. Instructors only observed video-recorded data from their classrooms. All

video-recorded data were returned to the researcher with the completed video reflection logs. All research records were stored securely and only those directly involved in the project and individuals responsible for research oversight had access to the records.

All video-recordings and audio-recordings were destroyed by the researcher after the final dissertation defense. There was no identifiable information within the transcripts, field notes, or artifacts. There was no plan for widespread publicity during or following the study. However, the study was submitted for publication following final approval by the dissertation committee.

Trustworthiness

Erlandson, Harris, Skipper, and Allen (1993) described techniques used within naturalistic research that establish trustworthiness: prolonged engagement, persistent observation, triangulation, referential adequacy, peer debriefing, member checks, reflexive journal, thick description, purposive sampling, and the audit trail. These techniques enable a naturalistic research study to meet criteria for credibility, transferability, dependability, and confirmability.

Prolonged engagement enables the researcher to establish relationships, build trust, develop rapport, and obtain accurate data from a wide scope. My 16-year tenure within the Bedford school district enabled me to establish positive relationships readily with the participants. Even though I did not have close personal relationships with any of the participants, we were familiar enough with each other that a foundation of trust was present before the study began. Mutual respect was shared between the participants and me throughout the study resulting in a positive rapport. Unintended distortions may have occurred as a result of the presence of the researcher and video equipment or the desire of

the instructors to please the researcher. Mrs. Moore in particular was almost too accommodating. On more than one occasion I reminded her to "Just do what you would normally do as if I weren't here." At least 34 hours were spent collecting data and interacting with the participants at BMS.

Persistent observation allows the researcher to obtain in-depth and accurate data and enables the researcher to distinguish between relevant and irrelevant data and to identify deceit. Being aware of the parent information meetings and the pre-enrollment packets provided to students enabled me to collect artifacts that were meaningful to the study. In addition, after persistent observation of the boys' class it was determined that the questions they asked the instructor were relevant and related to the lesson and not a mere attempt to distract the instructor as originally perceived.

Triangulation is a technique used to verify data. Various sources included multiple participants, interview notes, fieldnotes and video-recorded data from multiple days, and multiple documents.

Referential adequacies refer to the materials that provide the researcher with an understanding of the desired perception within the school. Specific materials were not collected by the researcher, however they were observed by the researcher throughout the school. A focus on student achievement and involvement was evident on the walls of the school and within the daily announcements. Student artwork lined the walls of the commons area where the students ate lunch and gathered before and after school. Students were encouraged over the intercom to get involved in athletic programs by participating in tryouts. Awards were given for students' *EXPLORE Test* results. Free breakfast was offered during the *Oklahoma State Criterion Reference Tests*.

Peer debriefing adds credibility when an additional person who has a general understanding of the study assists in the analysis of the data. A person within the doctoral program at OSU was identified by the dissertation committee as a qualified peer debriefer. She was asked to confirm the accuracy of the video transcriptions and to analyze 10% of the coded data for consistency. She identified a code that was not included on the list of codes. An error in the coding of two different sections of the transcript was identified and corrected. As a result, I double-checked all of the transcripts and no other errors were identified.

Member checking also supports credibility by allowing participants to review data and provide feedback. All participants who engaged in an interview reviewed their interview transcripts. If questions arose that needed clarification, then those questions were enclosed within parentheses and colored orange in the transcript given to the participants. Participants were asked to write a response in the margin and provide the researcher with either a signed copy of the transcript or an e-mail if there were no clarifications to be made. Mrs. Moore identified two errors in which the wrong word was included in the transcript. The correction was made in the transcript by striking a line through the original error and inserting the correct wording. Both instructors received transcripts of all of the video transcription that was recorded from their classrooms and both responded with no recommendation for changes. Finally, both instructors reviewed the codes assigned throughout the transcripts and responded with no recommendation for changes.

A reflexive journal provides an opportunity for the researcher to document decisions made throughout the study which contributes to the study's credibility.

Beginning March 9, 2010 and throughout the study, a reflexive journal was maintained. Daily entries were made in this journal with the exception of days resulting in limited progress. In addition to the journal, brief entries were made in a monthly calendar. The reflexive journal and the monthly calendar were useful in confirming dates and activities throughout the study to establish transferability, dependability, and confirmability.

Thick description and purposive sampling also contribute to the transferability of the study. Fieldnotes and video transcripts included sounds and visual descriptions of classroom activities. In addition, photos of the empty classrooms were taken the evening of March 11, 2010 to establish a visual record of the classrooms being observed. Purposive sampling was used to select the most relevant classrooms to study.

An audit trail leads to dependability and confirmability of the study when six categories of materials are included: raw data, data reduction and analysis products, data reconstruction and synthesis products, process notes, related materials, information pertaining to instrument development. Raw data included fieldnotes, interview recordings and transcripts, video recordings and transcripts, instructor notes, video preview logs, video reflection logs, and email correspondence. Raw transcript data was reduced by coding and copying the data to a separate document that placed the codes for the single-sex class and coeducational class of each teacher side-by-side on the same page for comparison. The horizontal space between codes was eliminated to condense the data. The codes were then reorganized so those for the same instructional events and strategies were placed together. Space was added between codes of different instructional events and strategies to identify easily the beginning and end of each code. This produced a side-by-side comparison of the single-sex class and coeducational class for both teachers.

Process notes included the reflexive journal and the calendar of events pertaining to the study. Related materials included student work samples, a student textbook, master schedule, school map, class roster, parent meeting description on calendar and presentation slides, pre-enrollment packets, enrollment sheet, photographs of the two empty classrooms, school report cards, and test specifications.

As a result of these techniques, the study has met criteria for credibility, transferability, dependability, and confirmability as described by Erlandson et al (1993). Specifically, the techniques of prolonged engagement, persistent observation, triangulation, referential adequacy, peer debriefing, member checks and reflexive journaling provide credibility. Thick description, purposive sampling, and reflexive journaling support transferability. The audit trail and reflexive journal foster dependability and confirmability.

Data Analysis

Nastasi (2009) identified the researcher as the primary instrument for analysis and interpretation. She described an inductive-deductive continuum of data analysis. The inductive approach to data analysis involves the identification of themes and patterns of data that reflect the participant's perspective, or emic perspective and is influenced by the researcher's theoretical perspective. Conversely, the deductive approach to data analysis involves the use of preexisting theoretical frameworks to code data which requires interpretation of participant's views and behaviors from the researcher's perspective, or etic perspective. She recommended an integrated approach that includes emic and etic perspectives that reflects both existing theory and the participant perspectives. Data for

this study were analyzed according to the integrated approach. Analysis began as data were collected and classified.

Deductive Analysis

A deductive coding approach was used to analyze instructional events and strategies. Instructional events and strategies were identified and categorized using Gagné's (1985) theory of instruction as the theoretical framework. Deductive analysis was conducted in three phases: coding, data reduction, and data reconstruction.

Phase I. Coding of fieldnotes and transcripts began June 23, 2010, after a preliminary reading of the data. Codes were initially assigned to Gagné's (1985) instructional events and to Gagné and Medker's (1996) instructional strategies with additional codes identifying the case and source of data. (See Appendix D for the list of codes.)

Fieldnote and transcript data were copied to a Microsoft Word document in which the text was positioned along the middle of the page separated with a single line from the space where notes and codes were handwritten on the right side and from the space where a line number was typed on the left side. Emic codes were created for instructional strategies that were not included in the theoretical framework. Handwritten codes were typed into the space on the right side of the code document with a line number beginning July 15, 2010, and the documents were saved with "notes and codes" in the title.

All coded fieldnotes and transcripts were e-mailed as attachments July 20, 2010 to a peer debriefer with a copy of the list of codes used. She was instructed to review a minimum of 10% of the coded documents for consistency, 47 pages, as recommended by Nastasi (2009). The peer debriefer replied August 1, 2010 with three identified

inconsistencies. One code was omitted from the list and an error in the coding of two different sections were identified and corrected. No additional errors were identified after reviewing the coded documents.

Each instructor received coded fieldnotes and transcripts from her classes and was asked to review a minimum of 10% of the coded document for accuracy, 20 pages from Mrs. Davis and 28 pages from Mrs. Moore. Mrs. Moore replied July 22, 2010 with no recommendations for change. Mrs. Davis replied August 8, 2010 indicating no discrepancies.

Phase II. Data reduction began July 26, 2010 by selecting and copying the typed codes on the right side of the coded document and copying them to a new Microsoft Word document with "original comparison" in the title. Original comparison documents were created for fieldnotes, video-recorded data, and interview transcripts. Formats for original comparison documents for the video-recorded data were identical for each instructor.

Codes from the single-sex class were positioned on the left side of the page and codes from the coeducational class positioned on the right side of the page for fieldnotes and video-recorded data. Codes from interview transcripts were selected and copied to create original comparison documents showing codes between the principal and counselor and between Mrs. Moore and Mrs. Davis. Actual comparisons were not made between these individuals. All horizontal spaces between codes were deleted to reduce the document to a manageable size and saved with "condensed comparison" in the title. Codes remain in their original order within the "original comparison" and "condensed comparison" documents.

Phase III. Data reconstruction began July 28, 2010 by selecting and copying codes from the "condensed comparison" documents and pasting them to a new document with "organized comparison" in the title. All of the same codes were grouped together within each column. Horizontal space was added between each group of codes to facilitate comparison.

Some codes were identified during data reconstruction that had been misnamed. Raw data were reviewed to identify the correct code and corrections were made within the "original comparison," "condensed comparison" and "organized comparison" documents. Observed incidences of instructional events and strategies were then counted and displayed in chart form using Microsoft Excel. The Microsoft Excel document was recreated in Microsoft Word format for reporting (See Appendix E).

Inductive Analysis

An inductive coding approach was used to analyze data that did not fit within the established categories provided by the theoretical framework. Emic instructional strategies were added to the original list of codes. Additionally, Patton (2002) recommended content analysis for case studies which involved searching data for recurring words or themes. Coding, data reduction, and data reconstruction were also phases of inductive analysis.

Phase I. Handwritten notes were made in the margins next to segments of data that represented repeating words or themes which coincided with Phase I of deductive analysis that began June 23, 2010.

Phase II. Inductive data reduction began August 6, 2010 following deductive analysis. Segments of data with handwritten notes were manually cut out and assembled

in a restricted area. This allowed the researcher to physically move segments of data as needed.

Phase III. Data reconstruction began August 7, 2010 as segments of data were manually sorted and combined into related thematic areas. Thematic areas included enrollment, interactions, movement, bullying behaviors, academic expectations, willingness to volunteer, disciplinary interruptions, professional development, and evaluation. Thematic areas were listed and described in no particular order. Original transcripts remained intact and were reviewed repeatedly for reference and context.

Mertz and Anfara (2006) described various roles of a theoretical framework within qualitative research. Gagné's (1985) theory of instruction provided focus to the research questions and to the types of data collected and analyzed throughout this study. This theoretical framework provided categories which were utilized during deductive data analysis. Relying heavily on a theoretical framework may have concealed some aspects of the data even though deductive and inductive analyses were conducted. As a result of inductive analysis, themes unrelated to the theoretical framework were discovered.

Reporting Results

A draft of the final report was shared with the participants, and a copy of the final report was given to the administrative team of BSD. In addition, the final report was presented to the dissertation committee for final approval before it was submitted for publication. Transferability of the findings to other populations or contexts is the responsibility of the consumer (Nastasi, 2009).

CHAPTER IV

PRESENTATION OF DATA

The purpose of this case study was to gain a better understanding of the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math within a public middle school using Gagné's (1985) theory of instruction as a framework. Data within this chapter were organized categorically in chronological order (classroom descriptions, artifact descriptions, field observations, video-recorded observations, and interview data) with the intention that the data be used to further the understanding of instructional events and strategies within the classrooms where the instructors taught both single-sex and coeducational math. In no way was there an attempt to compare the two instructors.

Two types of observational data were collected during the study: physical descriptions and instructional observations. Physical descriptions were included of artifacts and the classrooms. Instructional observations included fieldnotes and video recorded data. (See Appendix E for incidence of observed instructional events and strategies.) Interview data were collected through a 1-1.5 hours sessions with the school principal, one of two counselors, and the two instructors. Transcriptions of these interviews were provided to the interviewees.

Classroom descriptions

The study took place within two pre-Algebra classrooms located within the same hallway in Bedford Middle School (BMS). Mrs. Davis taught a male-only class and four coeducational classes in one classroom. Down the hall, Mrs. Moore taught pre-Algebra in two female-only classes and one coeducational class in addition to Algebra I in two coeducational classes inside the other classroom.

Mrs. Davis' Classroom

Mrs. Davis' classroom was a comfortable space, well lit, and filled with bright, yet informative, posters and signs. Some of the math-related posters illustrated a variety of labeled geometric shapes and comparisons between fractions and decimals. Other signs encouraged students to share ideas, plan ahead, think, make an effort, stop and listen, and question. Some signs communicated great expectations for students. Various colored cutouts of cake with a candle were sorted and attached to the wall according to the months of the year. Each student's name and a date were handwritten on the cutouts. Samples of students' work rustled quietly against the blackboard below a colorful poster that read "W.O.W. Wonderful Outstanding Words" as the air conditioner fan blew quietly from the ceiling. The bulletin board had a March calendar, her class schedule, and expectations for the classroom.

Arrangement of the classroom prevented any one wall from being referred to as the front of the room. Her desk was located along one wall with tables located beside it holding objects and supplies the students could easily access independently such as the stapler, facial tissues, and grading utensils. Additionally, a set of white wire baskets on rollers contained papers the students completed and submitted and additional white paper for the students to use as needed. She presented information from the document camera

from this wall, yet the camera projected on the opposite wall on a white screen that scrolled down in front of a wider dry-erase board. On an adjacent wall, the date and the assignment for the day were handwritten in cursive chalk on the blackboard. A round white-faced clock was positioned on the opposite wall surrounded by inspirational posters that displayed "Life Principles" and "Great Expectations Tenets." Large plastic tubs containing teaching materials sat on top of the wardrobe closet next to the door.

Thirty student desks were arranged in rows, half on one side of the room and the other half on the opposite side of the room. Each group of desks faced the other with a single aisle of four feet between the two groups. Students on both sides of the room turned their heads slightly to read the information on the white screen. Five student desks had burgundy colored chairs and 25 had blue colored chairs. There did not appear to be an obvious arrangement of the mismatched chairs. Mrs. Davis did not rearrange the desks throughout the year, emphasizing "I never rearrange my classroom, the desks the way they are arranged…I really like the arrangement now. They all have pretty much an equal line of vision to the screen."

Student seating assignments were based on each student's displayed effort in the classroom. She assigned students who "work harder towards the front" and the students who "don't work, that don't do anything closer to the back." She emphasized "the ones that are really trying, they get the preferential seating." She explained the "front" referred to the desks in the front of each row. Because she had sections of desks on two sides of the room, she had twice as many seats considered to be in the "front." In addition, students that needed to be in close proximity to her were assigned to the row in front of her desk. She acknowledged student seating assignments were "kind of mixed" at random

at the beginning of the school year. Student seating assignments were changed periodically to accommodate individual student needs or to separate students who were creating distractions.

Mrs. Moore's Classroom

Mrs. Moore's classroom was pleasantly decorated with inspirational posters displaying natural hues. Various pictures of the sky, including hot air balloons, hang gliders, mountain tops, and a city skyline, were stapled to the bulletin board next to the March calendar. Posters of photographs depicting perseverance, potential, and challenge lined the wall vertically at the entrance. Posters of various cats from Garfield to a baby tiger cub were hung over a student work space. Soft green ivy adorned the wall bordering the blackboard and the white dry erase board. Landscape posters lined the top of the black board, and colorful posters of geometric shapes within stained glass or quilt patterns lined the top of the dry erase board. Classroom rules were hand written on bright pink rectangles: "Be prepared each day." "Always use pencil!!" "Be courteous!!" "Respect one another." "Raise your hand!!" "No gum or candy!" Cutout letters spelled "MATH CENTER" next to three large posters illustrating concepts of estimating, exceptions, and two of a kind.

Various furniture items lined the walls including two tables that appeared to be student work stations. One work station appeared to be a general work station that included a computer on a table with a single student chair. Next to this table was a wood-grained two-drawer file cabinet with an arrangement of silk flowers on top. A white book shelf that contained neatly stacked books and a coordinating silk flower arrangement was next to the file cabinet. Various personal photographs and knickknacks were arranged on

shelves within a wooden hutch. A silk plant sat on a wooden stool next to the hutch. The blackboard was along the adjacent wall and had two blue-toned posters one of which listed the steps of solving math problems. Mrs. Moore's desk was located in the corner next to a table that held the document camera which projected the image behind her desk on to a white screen that scrolled down in front of a wider white dry erase board. The front of the classroom throughout the study was perceived to be the area behind her desk where the white screen was located. Thirty calculators were stored in blue storage pockets hanging from the top of the dry erase board. The second student work station was labeled "MATH CENTER" and consisted of a table with three student chairs in front with an Algebra I book display and other teaching supplies. A book shelf lined the wall that was covered with blue and yellow fabric. Five wire baskets were placed along the top of the bookshelf below a blue and green apple attached to the wall. A vase of yellow silk flowers was placed on one side of the wire baskets and a short segment of ivy greenery was placed on the other side. The round white-faced clock was located on the wall above the wire baskets. Four yellow and black butterflies of varying sizes decorated the space above the wardrobe closet next to the door.

Desk arrangement varied. During the observations, 16 of the 29 desks faced the front of the classroom where the dry erase board was located and the other13 were turned to face the direction of the blackboard. Conversely, all desks were arranged in traditional rows facing the dry erase board during the video-recordings. There were no mismatched chairs in her classroom. Mrs. Moore changed the arrangement of student desks frequently so the arrangement would be "conducive and comfortable for students to learn" depending on the activities planned for the day. Throughout the school year, student

desks may have been aligned in a traditional pattern of single file rows as seen on the video-recorded data, arranged so that two groups of desks faced two different directions as described in the fieldnotes, or organized into groups of three or four as described by Mrs. Moore. She selected each arrangement based on each student's ability to see her and the dry erase board at the same time.

Student seating assignments were determined by the displayed effort and special needs of individual students; she stated, "If students are struggling, I would definitely place them close to the front so I could keep an eye on their progress. Plus, I would place students with special conditions close to the front, too." She defined the "front" as close proximity to her location, depending on the arrangement of the student desks. Student seating was assigned alphabetically at the beginning of the year and then adjusted based on student needs. Student seating assignments were changed periodically to accommodate individual student needs or to separate students who were creating distractions.

Artifact Descriptions

Artifacts included pre-enrollment information, NCLB annual report cards, video preview logs, and video reflection logs. Pre-enrollment information consisted of packets distributed to students and PowerPoint slides presented to parents that addressed scheduling procedures and options for the following school year. Pre-enrollment packets were obtained for the 2007-08 and 2009-10 school years while packets for the 2008-09 school year were unavailable. Presentation slides were obtained from the school website for the 2009-10 school year. Slides from previous years were unavailable because the previous slides were edited to create the most current presentation. NCLB annual report

cards for BMS were collected from the state department website for the 2006-07, 2007-08, and 2008-9 school years. Video preview logs and video reflection logs were designed by the researcher using Gagné's (1985) theory of instruction as a framework. Video preview logs were provided to both instructors before they provided instruction in each video-recorded class so they could record planned instructional events and strategies. Video reflection logs were provided to each instructor when she received a copy of the video-recorded data so she could reflect on the actual instructional events and strategies used during each video-recorded class period.

Pre-Enrollment Information

Pre-enrollment information was available electronically on the school website and in print format. Information in the original pre-enrollment packet distributed for the 2007-08 school year differed from the enrollment guide distributed for the 2009-10 school year. Both pre-enrollment packets included a section entitled "Same-Gender Classes" that read,

> "Same-gender classes will be offered in Pre-Algebra and Science for the 2007-2008 school year. Research shows that students placed in same-gender classes for math and science tend to score higher on standardized testing. Please refer to the articles at the end of this booklet for more information on same-gender classes.
>
> These classes are totally VOLUNTARY. If you decide you would like to try this type of class, circle your choice. If you decide against it, just circle the regular class on your enrollment form."

However, the version for the 2009-10 school year replaced the word "science" with "English" even though single-sex science classes were available instead of single-sex English classes. The counselor cited oversight as the cause of the discrepancy. Additionally, the original enrollment guide included two articles on the last two pages of the guide that addressed "same-gender education" and "same-gender classes." There were no articles included in the version for the 2009-10 school year. The counselor indicated the omission was caused by the BPS print shop and corrections would have been too costly and time consuming. No one mentioned the errors to her and she assumed parents did not realize the articles had been omitted.

The enrollment card for the 2009-10 school year included a section entitled "FYI" that read,

> "Same-gender Pre-Algebra and Science classes are being offered next year. Research shows that students placed in same-gender classes for math and science tend to score higher on standardized testing. This is totally VOLUNTARY. If you decide you would like to try this type of class, circle your choice. If you decide against it, just circle the regular class."

The enrollment card listed "Same Gender Pre-Algebra – Female," "Same Gender Pre-Algebra – Male," "Same Gender Science – Female," and "Same Gender Science – Male" as class options along with the coeducational options. The enrollment card was to be returned to the counseling office by March 13, 2009.

PowerPoint slides presented during the pre-enrollment meeting, addressing the 2009-10 school year, for all parents were obtained electronically from the school website. There was no information about the single-sex class options within the slides. Scheduling

information for the parent meeting was posted on the school website and printed in the local newspaper.

NCLB Annual Report Cards

A focus on data from the No Child Left Behind Act Annual Report Cards for the 2006-07 through 2008-09 school years at Bedford Middle School revealed increases and decreases in test scores. Timeliness of the report card distribution and changes in performance level standards made it difficult to rely solely on this source of data.

Three hundred twenty-four females and 353 males were tested in the 2006-07 school year, 313 females and 321 males in 2007-08, and 330 females and 284 males in 2008-09 (See Table 4.1). The year before single-sex classes were implemented at Bedford Middle School, 2006-2007, the gap between females and males at the advanced level was 11 percentage points favoring males (See Table 4.2). All other performance levels favored females by eight percentage points at the satisfactory level, two percentage points at the limited knowledge level, and two percentage points at the unsatisfactory level.

Table 4.1

Number of Students Tested by Gender

	Gender		
Year	Female	Male	Total
2006-07	324	353	677
2007-08	313	321	634
2008-09	330	284	614

Note. Data provided by No Child Left Behind Act Annual Report Cards for the 2006-07 through 2008-09 school years for Bedford Middle School.

Table 4.2

Percentage of Math Scores by Performance Levels at Bedford Middle School

Level	Female	Male	Total
		2006-07 School Year	
ADV	25	36	31
SAT	58	50	54
LK	11	9	10
UN	6	4	5
TOTAL	100	99	100
		2007-08 School Year	
ADV	22	27	24
SAT	62	57	59
LK	15	12	13
UN	2	4	3
TOTAL	101	100	99
		2008-09 School Year	
ADV	27	37	32
PROF	43	34	39
LK	16	16	16
UN	15	14	14
TOTAL	101	101	101

Note. Totals range between 99 and 101 as a result of rounding decimals. Levels were reported on the Oklahoma Core Curriculum Tests: ADV – Advanced Performance Level, SAT – Satisfactory Performance Level (replaced by PROF – Proficient Performance Level in 2008-09), LK – Limited Knowledge Performance Level, UN – Unsatisfactory Performance Level.

Test results from the year single-sex classes were implemented at Bedford Middle School, 2007-08, revealed a reduction in the gaps between males and females to five percentage points at the advanced level and five percentage points at the satisfactory level. However, the total number of students performing at satisfactory level and above decreased from 85 percent to 83 percent. Sixty-one students were enrolled in single-sex math classes in the first year.

The performance gap appeared to return in the year following implementation of single-sex classes, 2008-09, with only 62 students enrolled in single-sex math classes. Ten percentage points favored males at the advanced level and nine percentage points favored females at the proficient level. A possible explanation for the return of the performance gap was a change in the standards for each performance level for the 2008-09 school year. The State Board of Education raised the expected performance levels for eighth grade math and reading in 2009 (Oklahoma State Department of Education, n.d.). Among the changes, title of the "satisfactory" performance level was changed to "proficient".

Video Preview Logs

Video preview logs were designed by the researcher to include instructional events defined by Gagné (1985). Video preview logs were given to each instructor with a copy of Table 2.1 on the day video-recording equipment was set up in the classroom. The purpose of the video preview log was to collect data from the instructor about planned instructional events and strategies.

Both instructors completed video preview logs of the instructional events and strategies incorporated in the single-sex and coeducational classes before conducting

three lessons that were video-recorded. Notes by both instructors indicated no difference in most of the instructional strategies between the single-sex and coeducational classes. However, Mrs. Davis recognized one difference between the two classes in strategies used to gain attention. Mrs. Moore recognized differences between the single-sex and coeducational classes in strategies used to gain attention and to provide feedback. Both instructors identified a variety of anticipated challenges.

Mrs. Davis indicated the majority of strategies used to incorporate instructional events were the same between the male-only and coeducational classes. She informed students in both classes of the objective by using verbal statements and examples. Recall of previous knowledge and individual steps of a task were common in both classes. She listed verbal explanation, emphasis on rule application, and variety of examples as strategies used to present content in both of her classes. Learning guidance was provided by using a variety of examples. Eliciting performance was incorporated by requesting student demonstration of knowledge, fading cues, and advanced difficulty. Providing feedback was accomplished by communicating degree of correctness. She identified only informal assessment as the strategy used to measure student performance, and identified repeated practice and variety in both of her classes to enhance retention and transfer.

The only difference Mrs. Davis identified between the single-sex and coeducational classes was the strategies used to gain attention. In the male-only class strategies were gestures, voice tone and volume, and audio-visual examples while the same were used in the coeducational class with the exception of gestures. Voice tone became more authoritative while increasing volume to gain attention. Audio-visual

examples were provided using the document camera during content presentation. Gestures were directional in nature.

Anticipated challenges listed by Mrs. Davis varied between the male-only and coeducational class. Focusing on the task, solving multi-step problems, laziness, unwillingness to try, and lack of listening were listed as anticipated challenges in the male-only class. The only anticipated challenge identified in the coeducational class was a lack of student responses to oral questions that were to provide feedback of understanding.

Mrs. Moore indicated no differences between the single-sex and coeducational classes in most of the strategies used to incorporate instructional events. She informed students of the objective by utilizing verbal statements and examples in addition to questions. Recall of previous knowledge, individual steps of a task, brainstorming, and discussing specific examples of squaring numbers were identified. She preferred the use of demonstration and illustration to present content. Learning guidance was provided by a variety of examples. She utilized student demonstration, progression of concepts, and progression of quality standards to elicit student performance. Informal and formal assessments in the form of assignments submitted for a grade were included. She identified only repeated practice to enhance retention and transfer.

Mrs. Moore recognized differences between the single-sex and coeducational classes in the strategies used to gain attention and provide feedback. She identified the "problem of the day," voice tone, and gestures as attention gaining strategies in the female-only class and added the bell tone as another attention gaining strategy in the coeducational class. Providing feedback was accomplished in the female-only class by

communicating degree of correctness. Additionally, corrective feedback was added as a strategy used in the coeducational class.

Mrs. Moore provided limited information regarding anticipated challenges. The one difference between the female-only and the coeducational classes was their understanding of the Pythagorean Theorem formula. She identified a lack of volunteer participation in demonstrations within the coeducational class.

Video Reflection Logs

Video reflection logs were designed by the researcher to include instructional events defined by Gagné (1985). Video reflection logs were given to each instructor with a copy of the video-recorded data. The purpose of the video reflection log was to collect data from the instructor about actual instructional events and strategies after she viewed and reflected on the video-recorded data.

Both instructors completed video reflection logs after reviewing video-recorded data of instructional events and strategies in the single-sex and coeducational classes. Notes by Mrs. Davis indicated no difference in any of the instructional strategies between the single-sex and coeducational classes, yet she listed differences in experienced challenges. Mrs. Moore recognized differences between the single-sex and coeducational classes in strategies used to gain attention, stimulate recall, and provide feedback; she identified no differences in experienced challenges.

Mrs. Davis submitted identical instructional strategies on the reflection logs for the male-only and coeducational classes. Gaining attention was achieved by voice tone and volume and audio-visual strategies. Verbal statements were used to inform students of the objective. Recall of prior learning involved focusing on individual steps of a task.

Content presentation included demonstration, verbal explanations, and a variety of examples. Fading cues were listed as a strategy to elicit student performance. Providing feedback consisted of degree of correctness while assessing performance included informal strategies. There were no indicators for providing learning guidance or enhancing retention and transfer.

Mrs. Davis noted only differences in experienced challenges between the male-only and the coeducational classes. Experienced challenges in the male-only class consisted of lack of focus, unwillingness to work, and inadequate preparation while only lack of participation and homework completion were noted in the coeducational class. She indicated she was feeling ill during the week of video-recorded instruction and included that as an additional challenge.

Mrs. Moore indicated no difference between the female-only and coeducational classes for most of the instructional strategies. Verbal statements, demonstrations, and examples were listed as strategies used to inform students of the objective. Demonstration and emphasis on distinctive features were identified as strategies used to present content. Learning guidance was provided by working example problems together. Student demonstration on homework and a progression of quality standards were strategies used to elicit student performance. Assessing performance was incorporated formally with homework assignments submitted for a grade. Repeated practice was indicated as the strategy to enhance retention and transfer.

Differences were indicated in the strategies used to gain attention, recall prior learning, and provide feedback. She indicated voice tone as a strategy used in the female-only class and gestures as a strategy used in the coeducational class. Displaying a

problem on the white screen at the beginning of each class period was listed as a strategy to gain attention for both classes. She listed recall of pre-requisite rules and concepts as a strategy in the female-only class and recall of previous knowledge as a strategy in the coeducational class to stimulate recall of prior learning. Recalling individual steps of a task was identified in both classes. Degree of correctness and working problems together were strategies used to provide feedback in the female-only and coeducational classes while corrective feedback was also added in the female-only class.

Mrs. Moore did not identify any differences between the female-only and coeducational classes in experienced challenges. Both classes struggled with using formulas to solve problems, specifically identifying information to enter into the formula, squaring and cubing numbers as needed, and calculating fractions.

Field Observations

Wide-lens observation techniques described by Acheson and Gall (1997) were used during field observations. Anecdotal records were created during the eight classroom observations. A journal was maintained throughout the study. Fieldnotes were recorded as detailed informal spontaneous records of observations and conversations as recommended by Nastasi (2009).

Mrs. Davis' Male-Only Class

Twenty-one boys were on the first hour class roster for Mrs. Davis' single-sex male class. A maximum of 19 were observed due to absences and disciplinary assignments. Those observed appeared to be one African American, 13 Caucasian, three Hispanic, and two Native American students. Some of the boys were animated as they entered the fluorescent lit classroom, exchanging combinations of bumps and slaps as

they greeted each other, while others were more subdued. They mingled around the room until the bell rang, and then moved toward their seats as they continued talking to each other in a moderate volume. Daily intercom announcements came on loudly over the speaker shortly after the bell rang for class to begin.

Mrs. Davis entered the room followed by a male teacher the students recognized as their science teacher. Some of the students greeted him by name with confidence. The students became quiet after the principal announced the moment of silence over the intercom. Even though they were quiet, some of them communicated with hand signals to students across the room. After a brief period of time various sounds of tapping on the desk and whispering began. Mrs. Davis gave the boys a calm "Shhh" and the tapping and whispering stopped for a short time. Movement in the male-only class was almost constant throughout the class period. Individual boys walked from their desk to the pencil sharpener, Kleenex box, calculator bin, pencil container, stapler, waste basket, paper supply, or the instructor's desk. Occasionally, the movement included an interaction with other boys who were seated at their desk that appeared as a mock slap, unknown hand gesture, or awkward facial expression.

Mrs. Davis relied most heavily on verbal statements to gain attention in the male-only class followed by voice tone and volume, verbal gestures, and the use of rewards. The verbal statements included a combination of instructions related to the learning objective and directives to correct behavior. Even when Mrs. Davis used a firm tone, she remained calm and deliberate. Verbal gestures consisted of "Shhhh" and the boys seemed to respond initially. When they repeated the behavior, she responded with verbal statements in a firm tone. Rewards consisted of candy, stickers, and the opportunity to

listen to music. Candy was distributed at the end of the class period for students who remained seated before the bell rang to dismiss them. Stickers were attached to assignments and tests on which the boys performed well. Several students brought mp3 players to class and listened to them, using earphones while they worked on their assignment at the end of the class period.

Mrs. Davis informed students of the objective using visual cues and verbal statements. Visual cues were handwritten on the chalkboard and included the date and the assignment for the day. Verbal statements were utilized to inform students of the relationship between the objective for the day and objectives they had already covered and objectives they will learn in the near future. She stated, "Now you're ready to take those skills we worked on last week and apply them to the Pythagorean Theorem."

Students were asked to recall prior learning through inquiries about pre-requisite rules or concepts and individual steps of a task. She asked students to recall the proper use of decimals as it applied to multiplying and repeatedly requested students to recall the individual steps of solving a problem, "What do you do first? Second?..."

Mrs. Davis presented the content by demonstrating, explaining, and providing numerous examples. She demonstrated how to solve numerous examples of problems using the document camera. As she solved the problems from behind the document camera that projected on to the white screen, she explained to students the rules that applied to the solution. After providing the initial instruction, she began to ask the boys to fill in the blanks and to explain the steps taken to solve the problems.

Learning guidance was provided as she walked around the room answering questions the boys had about the assignment they were working on or the graded test they

had received. She listened patiently as the students described their misunderstandings, then calmly provided them with cues to help them realize their mistake. Some students raised their hands and waited for Mrs. Davis to come to them. Others asked their question aloud from their seat. She calmly made her way from student to student until all questions had been asked and answered.

Eliciting performance consisted of student demonstration and the use of cues. Mrs. Davis asked the class to respond to questions about the individual steps of solving a problem. She did not call on a specific boy unless one raised his hand to indicate he preferred to be called on. She asked questions to the class in general and expected the boys to demonstrate their knowledge by responding. At times she used cue words to help them if they seemed to be unsure. Additionally, students demonstrated their knowledge on the "bell work" and daily assignments.

Providing feedback was observed as degree of correctness. Students were instructed to write the number of problems they answered correctly at the top of the assignment they had graded. They were told what they did correctly when solving a problem before identifying what they did wrong. At times, the students were able to identify what they had completed incorrectly after she identified the part of the problem they had done right.

Mrs. Davis assessed the students' performance informally and formally while giving them the opportunity to assess themselves. Informal assessment consisted of questioning during demonstrations and assignments that were completed "together with the teacher." Formal assessment included assignments that were submitted for a grade and exams. Assignments included problems from the textbook, worksheets printed from

the textbook resources, or worksheets printed from a different resource. Problems that were assigned from the other resource consisted of rote practice problems that were used to supplement the procedure of solving the word problems assigned from the textbook resources. Mrs. Davis also encouraged students to assess their own understanding by encouraging them to identify problems they struggled with so they could go through the process of solving them together.

Enhancing retention and transfer was difficult to observe during a short time period. However, the "bell work" assignments that students completed at the beginning of the class period were observed to address objectives previously learned.

Mrs. Davis' Coeducational Class

The class roster for Mrs. Davis' second hour coeducational class consisted of 22 students, 11 boys and 11 girls. A maximum of 20 were observed due to absences. Those observed appeared to be two Asian girls, 10 Caucasian boys, six Caucasian girls, one Native American boy, and one Native American girl. Students began entering the classroom quietly a couple of minutes before the tardy bell rang. Two girls and three boys talked loudly to one another as they entered the room and stood beside their desks until the bell rang. There was no interaction among the students after the bell rang at 9:00. They pulled notebook paper out of their backpacks, looked at the white screen and began writing without receiving instruction to do so.

Mrs. Davis utilized verbal statements and the use of rewards to gain attention in the coeducational class, but not as frequently as the male-only class. The verbal statements consisted of instructions related to the learning objective and a single request to remove earphones. Rewards consisted of privileges to read and the opportunity to

listen to music. Several students read quietly at the end of the class period. Some students brought mp3 players to class and listened to them using earphones while they worked on their assignment. Mrs. Davis played soft instrumental music as students worked quietly on their assignments. She encouraged students to visit quietly at the end of the class period when they appeared to be finished with the assignment. Even with her encouragement, few of them spoke, and those who did used a very low tone.

Mrs. Davis informed students of the objective utilizing the same strategies as in the male-only class, visual cues and verbal statements. Visual cues remained unchanged from the male-only class. Verbal statements were almost verbatim to those used in the male-only class.

She asked students to recall prior learning in the same way as the male-only class by inquiring about pre-requisite rules or concepts and individual steps of a task. She asked students to recall the proper use of decimals as it applied to multiplying when the student asked a similar question that was asked in the male-only class. Additionally, she repeatedly asked students to recall the individual steps of solving a problem, "First step? Second step?..."

Mrs. Davis presented the content the same as she did in the male-only class, demonstrating, explaining, and providing numerous examples. She demonstrated how to solve numerous examples of problems using the document camera. The same diagrams, originally drawn under the document camera during the male-only class, were used which seemed to be an efficient use of time. After providing the initial instruction, she began to ask the students to fill in the blanks and to explain the steps taken to solve the

problems. There did not appear to be a difference in the use of cue words between the two classes.

Mrs. Davis provided learning guidance by walking around the room answering students' questions. Most of the students in the coeducational class worked quietly, asking few questions. As a result, the amount of time spent providing learning guidance appeared to be much less than in the male-only class.

Eliciting performance consisted of student demonstration and the use of cues. Mrs. Davis asked the class to respond to questions about the individual steps of solving a problem. She asked questions to the class in general and expected the students to demonstrate their knowledge by responding. Students in the coeducational class appeared to be engaged, yet they responded with silence most of the time. In one of our conversations after class, she remarked that the coeducational class being observed was not characteristic of her other coeducational classes because they "were so quiet." As in the male only class, students demonstrated their knowledge on the "bell work" and daily assignments.

Providing feedback was observed as degree of correctness and corrective feedback. Students were instructed to write the number of problems they answered correctly over the total at the top of the assignment they had graded. She showed students the correct responses as they graded the assignment and gave them the opportunity to write the correct answer.

Mrs. Davis assessed the students' performance informally and formally while giving them the opportunity to assess themselves as in the male-only class. Informal assessment consisted of questioning during demonstrations and assignments that were

completed “together with the teacher.” Formal assessment included assignments that were submitted for a grade and exams. Assignments included problems assigned from the textbook, worksheets printed from the textbook resources, or worksheets printed from a different resource. Problems assigned from the other resource consisted of rote practice problems that were used to supplement the procedure of solving the word problems assigned from the textbook resources. Mrs. Davis also encouraged students to assess their own understanding through identifying problems they struggled with so they could work together to solve them.

Enhancing retention and transfer was difficult to observe during a short time period. However, the “bell work” assignments that students completed at the beginning of the class period were observed to address objectives previously learned.

Mrs. Moore’s Female-Only Class

Eighteen girls were on the third hour class roster for Mrs. Moore’s single-sex female class. A maximum of 17 were observed due to absences. Those observed appeared to be one Asian, 13 Caucasian, one Hispanic, and two Native American students. Students began entering the classroom at 9:56 while speaking to one another in a moderate tone. Mrs. Moore entered the room shortly before the tardy bell rang at 10:00. She asked the girls to prepare for their assignment, and they responded, some by digging through their backpacks and others by walking to the closet and helping themselves to a textbook. Interactions appeared to be comfortable between the girls and the instructor. At one point, a couple of girls commented on Mrs. Moore’s pink shoes and how they liked the matching pants that also had flamingos on them.

Mrs. Moore used verbal statements and audio-visual equipment to gain attention. Verbal statements consisted of instructions related to the learning objective. Audio-visual equipment was used to convert information from the computer or document camera to visual images on the white screen. She displayed various images and video on the screen from her computer that appeared to interest the students. Additionally, she used the document camera to not only solve problems, but also to illustrate concepts such as proper calculator use.

She informed students of the objective utilizing visual cues and verbal statements. The former included a video clip that displayed the objective and handwritten list of assignments for the day while the latter were made at the beginning of the class period to connect what they learned the day before to the current objective and at the end of the class period to connect the current objective to what they will learn the following day.

Mrs. Moore asked students to recall prior learning using a variety of strategies including related situations or actions followed by individual steps of a task, pre-requisite rules or concepts, and previous knowledge. Students were asked to represent half of 70 in a variety of ways which were all related situations. Individual steps of a task involved completing the steps of a formula to solve for a problem. When she inquired about pre-requisite rules, she asked the girls what was needed to calculate the area of a triangle. She also asked the students to recall their previous knowledge of percentages.

Mrs. Moore presented the content by demonstrating, providing numerous examples, and explaining. She demonstrated how to solve numerous examples of problems using the document camera and the dry erase board. She also presented various illustrations of concepts, using colored paper plates cut to represent different percentages.

All of the concepts were explained through her drawing visual examples on the dry erase board.

Learning guidance was provided through a variety of visual examples, encouraging students to use learning resources, and teaching them to estimate their responses before solving the problem. Visual examples included drawings on the dry erase board and 3-dimensional objects related to the concept. Students were encouraged to refer to the resources they had with them: notes, textbook instructions, and calculators. Approximating their answer before they began solving the problem helped students determine if their final answer was reasonable.

Eliciting performance consisted of student demonstration and the use of bonus. Mrs. Moore asked students to provide the numbers within formulas used to solve problems. At times she pulled a popsicle stick out of a container on which a student's name was printed to identify the next student to be questioned. She expected the students to demonstrate their knowledge by responding to the questions. She encouraged students to attempt the more difficult problems by offering bonus points.

Providing feedback was observed as degree of correctness and encouraging or positive feedback. Degree of correctness was communicated verbally, "exactly" or "perfect." Encouraging or positive feedback, "there you go," was provided to students as well.

Mrs. Moore assessed the students' performance informally and formally while giving them the opportunity to assess themselves. Informal assessment consisted of questioning during demonstrations and content presentation. Formal assessment included assignments that were submitted for a grade and exams. Assignments included problems

from the textbook and worksheets. Mrs. Moore also encouraged students to assess their own understanding by identifying problems before they were graded so they could make necessary adjustments.

Enhancing retention and transfer was difficult to observe during a short time period. However, the assignments, placed on the white screen that students completed at the beginning of the class period, were observed to address previous objectives.

Mrs. Moore's Coeducational Class

The class roster for Mrs. Moore's first hour coeducational class consisted of 24 students, 8 boys and 16 girls. A maximum of 23 were observed due to absences. Those observed appeared to be one Asian girl, six Caucasian boys, 13 Caucasian girls, two Hispanic girls, and one Native American boy. Students began entering the classroom at 7:55. Some spoke to one another in a moderate tone while others entered silently. Mrs. Moore asked if everyone had their book as she entered the room shortly before the tardy bell rang at 8:00. On one occasion, she placed an illustration on the white screen from her computer and began asking related questions; on another occasion she asked students to exchange papers, and she read the correct answers aloud. Daily intercom announcements came on loudly over the speaker shortly after the bell rang for class to begin.

Mrs. Moore utilized verbal statements, change in voice and tone, and the use of audio-visual equipment to gain attention in the coeducational class. Verbal statements consisted of instructions related to the learning objective. Voice tone became firm and volume was slightly raised when students did not respond to directives. Audio-visual equipment was used to convert information from the computer or document camera to visual images on the white screen. She displayed various images and video on the screen

from her computer that appeared to interest the students. Additionally, she used the document camera to not only solve problems, but also to illustrate concepts such as proper calculator use.

She informed students of the objective utilizing visual cues and verbal statements as in the female-only class. Visual cues included a video clip that displayed the objective and handwritten list of assignments for the day. Verbal statements were made at the beginning of the class period to connect what they had learned the day before to the current objective and at the end of the class period to connect the current objective to what they will learn the following day.

Mrs. Moore asked students to recall prior learning using a variety of strategies, including pre-requisite rules or concepts followed by individual steps of a task, related situations or actions, and previous knowledge. When she asked about pre-requisite rules, the students were to recall the concept of "pi." Individual steps of a task involved completing the steps of a formula to solve for a problem and recalling order of operations. Students were asked to recall the relationship between doubling a number and squaring a number. She also asked the students to recall their previous knowledge of definitions.

Mrs. Moore presented the content predominantly by demonstrating and, to a lesser frequency, by providing numerous examples and explaining. She demonstrated how to solve numerous examples of problems using the document camera and the dry erase board. Various illustrations of concepts were presented using colored paper plates cut to represent different percentages. She explained all of the concepts as she drew visual examples on the dry erase board.

She provided learning guidance as in the female-only class through a variety of visual examples, encouraging students to use learning resources, and teaching them to estimate their responses before solving the problem. Visual examples included drawings on the dry erase board and 3-dimensional objects related to the concept. She encouraged students to refer to the resources they had with them: notes, textbook instructions, and calculators. Approximating their answer before they began solving the problem helped students determine if their final answer was reasonable.

Eliciting performance as in the female-only class consisted of student demonstration and the use of bonus. Mrs. Moore asked students to provide the numbers within formulas used to solve problems. At times she pulled a popsicle stick out of a container on which a student's name was printed to identify the next student to be questioned. She expected the students to demonstrate their knowledge by responding to the questions. She encouraged students to attempt the more difficult problems by offering bonus points.

Providing feedback was observed as degree of correctness, encouraging or positive feedback, and verbatim repetition. Degree of correctness was communicated verbally, "exactly" or "perfect." Encouraging or positive feedback, "there you go," was provided to students as well. Verbatim repetition of student responses was more common in the coeducational class.

Mrs. Moore assessed the students' performance the same as in the female-only class, informally and formally while giving them the opportunity to assess themselves. Informal assessment consisted of questioning during demonstrations and content presentation while formal assessment included assignments submitted for a grade and

exams. Assignments included problems taken from the textbook and worksheets. Mrs. Moore urged students to assess their own understanding by encouraging them to identify problems before they were graded so they could make necessary adjustments.

Enhancing retention and transfer was difficult to observe during a short time period. However, the assignments that were placed on the white screen that students completed at the beginning of the class period were observed to address previous objectives. Additionally, topics covered earlier in the school year were reviewed from the EXPLORE exam to prepare for the state-mandated tests.

Video-Recorded Observations of Instructional Events

Video-recording was another wide-lens observation technique recommended by Acheson and Gall (1997). Video-recorded data provided in-depth documentation that was particularly useful for capturing the unexpected and complicated events that occurred in the classroom as suggested by Nastasi (2009). It also allowed subtle and non-verbal interactions to be observed that were not evident otherwise (Brophy, 2004). Video-recorded data collection began after an initial test of the equipment and camera arrangements to allow participants the opportunity to get used to the video-recording aspect of the recorded observations. There were 20 hours of video-recorded data including a minimum of three class periods in each of the four classes.

Mrs. Davis' Male-Only and Coeducational Classes

Gaining attention. Mrs. Davis attempted to focus students' attention to the lesson in a variety of ways. Even before students entered the room, she placed a "bell work" assignment on the white screen from her computer or the document camera for students to begin solving before the bell rang for class to begin. Calling students by name and

verbal statements dominated the strategies used to gain students' attention in both the male-only and coeducational classes followed by voice tone and volume, gestures, and repetition in the male-only class.

Instances of calling students by name in the male-only class almost tripled those in the coeducational class where there was an equal number of boys and girls enrolled. There were 86 occurrences of calling boys by name in the male-only class over three days (32, 30, and 24) compared to 31 occurrences of calling students by name in the coeducational class during the same three days. Within the 31 occurrences, 25 were directed to boys and six were directed to girls. The majority of instances of calling students by name appeared to be as a redirection; however, there were examples of praise and recognition.

Verbal statements used to gain attention in the male-only class more than doubled those used in the coeducational class: 58 examples in the male-only class compared to 20 in the coeducational class over the same three days. Many of the verbal statements heard in the male-only class were behavioral corrections and directives. Verbal statements within the coeducational class were primarily instructional.

During times in the male-only class when Mrs. Davis did raise her voice tone and volume, it was observed as a calm strength. Gestures such as facial expressions or hand motions commonly accompanied the change in voice tone and volume. Repetition was common, whether it was repetition of instructions, directives, or answers to assigned problems. She did encourage repetition of answers at the end of a grading session.

Informing students of the objective. Mrs. Davis informed students of the learning objective in two ways, more frequently with verbal statements such as, "We're going to

find the area of this irregular shape," than with visual cues. Visual cues appeared on the chalkboard in the form of handwritten daily assignments to inform students what they would be doing that day.

Recall of prior learning. When asking students to recall information they had previously learned, Mrs. Davis suggested the boys needed more cues. However, the increased use of specific cue words was not identified within the video transcripts. Students in the male-only and coeducational classes were most frequently asked to recall individual steps of a task, "How do you find the area of a triangle?...First step, write your formula…second step, substitute. What are you going to substitute in place of your base?" There were 76 examples of recalling individual steps of a task in the male-only class compared to 51 in the coeducational class over the same three days. There were a few instances in which students were asked to recall related situations and pre-requisite rules or concepts.

Presenting the content. The most observed method of content presentation was verbal explanations, with 68 examples in the male-only class and 50 in the coeducational class, followed by example variety and demonstrations, with only a few examples in each class. Example variety referred to the examples of problems and demonstrations referred to the step-by-step solution of each problem. There were no modifications of assignment content that were not made in both male-only and coeducational classes. The total number of problems was reduced on one assignment, and the reduction occurred in both classes. Students were asked to complete the same problems on the assignment.

Providing learning guidance. Mrs. Davis provided learning guidance by presenting a variety of examples and applying rules in a variety of contexts. She worked

numerous examples of problems with the students using the document camera so all of the students could see what the solution looked like as they worked it together. Discussions during the time they worked problems together allowed students to share information, such as a connection between trapezoids and triangles.

Eliciting performance. Student demonstration of knowledge and skills on class assignments represented the most common request for student performance in the male-only and coeducational classes. Mrs. Davis expressed a concern that there would be an inequitable distribution of questions for calling on specific students and that calling on those students would make them a target for ridicule in the male-only class. Therefore, her expectation was for all students to respond when she asked questions. However, all students did not respond. Typically, only a few, at the most, would answer the questions asked of the class.

Providing feedback. Strategies for providing feedback varied between and within the male-only and coeducational classes. Most commonly used strategies in the male-only class were affirmative paraphrase, degree of correctness, verbatim repetition, corrective feedback, encouraging or positive responses, and degree of incorrectness. The strategies most prevalent in the coeducational class included verbatim repetition, affirmative paraphrase, degree of correctness, encouraging or positive responses, and degree of incorrectness.

Assessing performance. Mrs. Davis conducted informal assessments by questioning students throughout the class period to ensure they were learning the objective for the day. Examples of the informal questioning were almost identical

between the male-only and the coeducational classes. Formal assessments included assignments and tests on which students earned a grade.

Enhancing retention and transfer. It was difficult to observe strategies for enhancing retention and transfer during such a limited time. However, the problems that were placed on the white screen from Mrs. Davis' computer as "bell work" included problems and examples from material that was covered previously.

Mrs. Moore's Female-Only and Coeducational Classes

Gaining attention. Mrs. Moore utilized a variety of strategies to gain students' attention. She placed an assignment on the white screen from her computer for students to solve as she managed attendance. Calling students by name and verbal statements dominated the strategies used to gain students' attention in both the female-only and coeducational classes. Use of verbal gestures, voice tone and volume, and gestures, were implemented in the female-only class.

Eleven more instances of calling students by name occurred in the female-only class compared to the coeducational class. There were 96 occurrences of calling girls by name in the female-only class over three days compared to 85 in the coeducational class during the same three days. Within the 85 occurrences, 39 were directed to boys and 46 were directed to girls. Students called by name were most frequently being asked to answer a question.

Verbal statements in the female-only class quadrupled those used in the coeducational class: 28 examples in the female-only class compared to 7 in the coeducational class over the same three days. Verbal statements were used primarily to redirect their attention to the lesson.

Verbal gestures, voice tone and volume, and gestures were also implemented in the female-only class. Verbal gestures consisted of "Shhhh" in response to student interactions with each other during the lesson. Changes in voice tone and volume were commonly combined with gestures. Instead of raising her voice, she would lower the volume, tilt her head to the left and calmly raise her right arm to shoulder level with her palm facing the students.

Informing students of the objective. Mrs. Moore informed students of the learning objective using verbal statements and visual cues in the female-only and coeducational classes. For example, "We've been working on surface area. Now we're going from surface area to volume." Visual cues consisted of 3-dimensional models or examples that she displayed as she introduced the objective. Additionally, daily assignments were handwritten on the dry erase board.

Recall of prior learning. Students in the female-only and coeducational classes were most frequently asked to recall individual steps of a task. The number of examples, 120, was equal between the two classes over the same three day period. Students were typically asked about the next step in solving the equation. There were other instances in which students were asked to recall previous knowledge and pre-requisite rules or concepts.

Presenting the content. The most observed method of content presentation was verbal explanations, with 51 examples in the female-only class and 30 in the coeducational class, followed by demonstrations and example variety. Demonstrations were conducted equally between the female-only and coeducational classes. Some demonstrations involved student participation and were guided by Mrs. Moore, while

others consisted of step-by-step solutions of various problems. Example variety referred to the examples of problems in addition to 3-dimensional models displayed during the discussion. Three-dimensional models included various wooden shapes or representative samples of objects.

Providing learning guidance. Mrs. Moore provided learning guidance by presenting a variety of examples, applying rules in a variety of contexts, and encouraging students to estimate solutions before they began solving problems. She worked numerous examples of problems with the students, using the document camera so all students could visualize the solution together. Students applied the rules of measuring volume to various objects. She encouraged students to round decimals and calculate using whole numbers to determine if their final answer was "in the ballpark" of the estimated answer.

Eliciting performance. Mrs. Moore provided numerous nonverbal cues when asking students to demonstrate their knowledge. Nonverbal cues were identified more frequently, 43, in the female-only class compared to 31 in the coeducational class over the same three days. For example, if she asked a student how many sides on a triangle, she held up three fingers before the student had an opportunity to process and respond.

Students in both classes were frequently asked to describe methods they used to solve a problem. Mrs. Moore repeatedly stressed to students the possibility of multiple methods used to arrive at a correct answer.

Providing feedback. Verbatim repetition was the most commonly used strategy for providing feedback in the female-only and coeducational classrooms with 188 verbatim responses in the female-only class compared to 241 in the coeducational class over the same three days. Use of affirmative paraphrasing followed with 72 responses in

the female-only class compared to 53 in the coeducational class over the same three days. Degree of correctness and corrective feedback were also utilized in both classes.

Assessing performance. Mrs. Moore conducted informal assessments by questioning students throughout the class period to ensure they were learning the objective for the day. Examples of the informal questioning were almost verbatim between the female-only and the coeducational classes. Formal assessments included assignments and tests on which students earned a grade.

Enhancing retention and transfer. It was difficult to observe strategies for enhancing retention and transfer during such a limited time. However, the problems that were placed on the white screen from Mrs. Moore's computer as at the beginning of the class period included problems and examples from material that had been covered previously.

Interview Data

Interview data included one interview session with each of the two instructors, the principal, and a counselor totaling four sessions. The in-depth interview format, as described by Nastasi (2009), was a semi-structured process guided by the research questions. Each interview was 39-70 minutes in length and was held in a location convenient for the participant. Additional inquiry was made during the interviews to better understand the local history, implementation process, and professional development opportunities related to single-sex classes. (See Appendix C for interview questions.) Interview questions varied slightly between participants depending on their position within the school. Interview questions shared among participants will be

discussed collectively with the exception of questions asked of the two instructors that specifically reflect instructional events and strategies.

Principal and Counselor

What is the local history of single-sex classrooms within the Bedford School District? The beginning of single-sex classrooms in BPS began with a combination of discussions, interests, and research. Principals, counselors and teachers at the middle school level, grades six through eight, began discussing single-sex classrooms as a method to improve student academic achievement. A counselor at BMS read a journal article that addressed single-sex classrooms in the fields of math and science. An on-line search for more information ensued which led to a request to the assistant superintendent for approval. Approved was a pilot program for single-sex classrooms at the sixth, seventh, and eighth grade levels.

Single-sex classrooms were implemented at the eighth grade level in the 2007-08 school year for math and science. The single-sex option was made available at the sixth and seventh grade levels the same year for math. Single-sex classes have remained an option for students at the seventh and eighth grade levels since that time but were discontinued after the first year at the sixth grade level. At the eighth grade level, there were one section of science for males, two sections of science for females, one section of pre-Algebra for males, and two sections of pre-Algebra for females based on enrollment numbers. There were one section of math for males and one section for females based on enrollment numbers at the seventh grade level.

How were single-sex classrooms implemented within Bedford Middle School? Three goals supported the implementation of single-sex classrooms at BMS: comfortable

classroom environment, greater student interest in subject matter, and higher academic achievement. There was no indication of how the goals would be measured. The principal wanted to create a comfortable classroom environment where students who struggle with math and science felt more confident asking questions. The counselor emphasized the importance of offering parents and students the choice of a single-sex or coeducational classroom as an additional option.

The second goal was related to developing student interest in math and science subject areas. The principal hoped the single-sex classrooms would spark an interest in students for math and science. The counselor identified a difference in interest in the single-sex math and science classes. She observed more girls enrolling in the single-sex option than boys.

The third goal was related to improving student academic achievement in math and science. The principal acknowledged the need for continued improvement in math scores on state-mandated tests. She hoped the single-sex classes would benefit as many students as possible and, as a result, improve test scores. She believed that if students get the extra attention they need in the classroom and they feel confident with their abilities, then they will perform better on the tests. The counselor reiterated the importance of meeting students' educational needs.

Implementation of the single-sex classes involved communicating the single-sex option to students, parents, and teachers. The principal and counselor identified the pre-enrollment packet, the enrollment card, and student and parent meetings as sources of information. These artifacts are discussed in a previous section.

The principal briefly described the enrollment meetings for students that took place in March when students at the seventh grade level were informed of their class options for the following year. The principal indicated that the counselors meet with small groups of students throughout the day and explain to them what specific classes are available. Each student is given an enrollment packet that addresses frequently asked questions and course descriptions and an enrollment card. There was a place for student signature and parent signature on the enrollment card indicating that, "I have read and understand [sic] the scheduling process and course selection information."

The principal proudly described the enrollment meeting for parents that took place on March 2, 2010. Parents were invited to attend a large group meeting at which the counselors presented information from the enrollment packet the students had received previously. The meeting was advertised in the local newspaper and was posted on the school's on-line calendar.

The principal and the counselor emphasized the importance of parent involvement during the course selection process. If parents within the community were interested in encouraging their children to take advantage of any opportunity to be more successful, and, if being enrolled in a single-sex class would help them be more successful, then she, the principal, was confident the parents would select that option. She denied placing any student in the single-sex classrooms without the parent signing the enrollment card requesting that option. The counselor counted on the parents to make the decision about the single-sex option for the students because she did not believe many of the students would select that option on their own.

After students and parents chose their class options and submitted them, the counselor and the principal tallied the number of students who requested single-sex classes and compared them to available sections and personnel to ensure a sufficient number of coeducational classes. A minimum of 22 students were required for single-sex classes to be offered. Enough students enrolled the first year to offer six single-sex classes. Students who selected the single-sex pre-Algebra class were also likely to select the single-sex science class. A large majority of students who enrolled in the single-sex classes were enrolled by their parents; even so, the counselor did not recall any student requesting to be removed from any of the single-sex classes.

Four instructors were selected to teach the single-sex classes: Mr. Williamson taught a single sex female pre-Algebra class, Mrs. Moore taught a single-sex female pre-Algebra class, Mrs. Davis taught a single-sex male pre-Algebra class, Mrs. Parker taught two sections of single-sex female science and one section of single-sex male science. All of the instructors who were originally asked to teach single-sex classes continue to teach single-sex classes. Three years later, in the 2009-2010 school year, Mr. Williamson taught a single-sex female science class and a single-sex male science class while Mrs. Parker taught one single-sex female science class and Mrs. Moore taught two single-sex female pre-Algebra classes. The counselor viewed the instructors as partners and selected them with the principal based on their flexibility and openness to change.

Principal, Counselor, Mrs. Davis, and Mrs. Moore

What professional development opportunities, if any, have been provided for instructors who teach single-sex classes? Professional development opportunities for instructors teaching the single-sex math classes have been limited to district level

initiatives, informal collaboration, and the instructors' personal initiative to pursue opportunities individually. No professional development opportunities have been provided that specifically addressed single-sex classrooms. It is assumed that the same professional development opportunities apply to the instructors who teach single-sex science classes.

The district level initiatives included Schools Attuned, Great Expectations, and vertical teaming. The school district sends a few teachers from every building within BSD to Schools Attuned workshops each year. In addition, teachers have been encouraged to attend Great Expectations workshops. Most of the teachers in BMS have received Great Expectations training. Mrs. Davis declared the aspects of respect and motivation she learned in the Great Expectations workshop was useful in the single-sex classes. Vertical teaming was scheduled during formal professional development meetings in an effort to vertically align curriculum across the sixth, seventh, and eighth grade levels. Vertical team meetings also provided opportunity for professional collaboration between teachers in different buildings.

There is an atmosphere of informal collaboration within BMS. The counselor attributed this collaboration in part to the small size of the building and in part to the friendships between the teachers. Teachers frequently stand in the hall together between classes. Mrs. Davis collaborated on a regular basis with the teacher who taught pre-Algebra across the hall "because we're right there on hall duty all the time together so it's easier to communicate." Informal collaboration is commonly used to align curriculum horizontally to ensure the math teachers are within a couple of chapters of each other and to share instructional ideas. Mrs. Moore credited another math instructor who shared an

activity she used in her classroom to study probability. In addition, Mrs. Moore had received a grant to purchase a classroom set of wooden shapes that other instructors share as visual examples.

Informal collaboration also occurred between teachers whose classrooms were not in close proximity. Mrs. Davis collaborated on a frequent basis with Mr. Williamson who taught a basic level pre-Algebra class that was similar to the basic level pre-Algebra class she taught during a different hour and a single-sex male science class that included many of the same students enrolled in her first hour single-sex pre-Algebra class. Mr. Williamson had a first hour planning period, so it was somewhat convenient for him to visit with her even though his classroom was in the next hallway. She collaborated with him frequently to address needs of the basic pre-Algebra class. However, she also appreciated the camaraderie they had developed as the only two teachers who taught the same group of male students in a single-sex setting. Because they communicated about the students they shared, it enabled them to have a combined effect on those students.

Teachers within BMS have had opportunities to pursue professional development opportunities on an individual basis. In addition, there is value placed on the professional experience of the veteran teacher and the ability to draw from that experience to instruct students most effectively. Mrs. Moore valued the experience she had at a math related workshop, Math Connection, at the University of Tulsa. She associated her experience at Math Connection with various demonstrations she performed with students in the classroom. She explained the recent opportunity for math instructors from BMS to attend a national math conference was cancelled due to budget restraints. Mrs. Davis enjoyed workshops that promoted the integration of multiple subject areas. She has worked with

other teachers to integrate math and science concepts involved in building igloos, but scheduling and a lack of adults available for supervision prevented that activity from occurring this year (IA).

What are the challenges of the single-sex classes? One of the challenges cited by the principal and the counselor was related to parent and student interest. Their initial concern was whether or not parents and students would be interested in selecting single-sex class options. The counselor expressed empathy for "students who felt reluctant because their parents had selected the single-sex option even though the students did not want it." Then the challenge became scheduling the single-sex classes so students may enroll in multiple single-sex classes during the same semester.

The principal denied the presence of classroom challenges in the single-sex classes. She claimed, "Students were not ever referred for discipline or behavioral issues, and nobody ever complains." She identified "no drawbacks" from an administrative standpoint.

Mrs. Davis and Mrs. Moore agreed focusing students' attention was a challenge in both of the single-sex classes. Students seemed to ask numerous questions, both on topic and off. As a result, various strategies were used to gain and maintain attention. Mrs. Davis explained, "A lot of times, if I call on students, it's because they are not paying attention or doing what I expect them to be doing at the time and it's just another way to redirect their attention." Mrs. Moore indicated adjustments in her volume and tone was effective in maintaining the girls' attention. However, the counselor described one instance in which a girl was removed from the single-sex classroom due to "some pretty serious drama" among several of the girls.

Mrs. Davis claimed the boys in the single-sex class were demanding in their need for immediate feedback and their interest in information pertaining to upcoming changes that may require an adjustment on their part. She suggested, “They lack confidence for whatever reason, and they need that constant reassurance.” She attributed the lack of confidence to the boys’ belief that “they’re in the single-sex class because they’re not good at math,” but she acknowledged parents’ rationale for selecting the single-sex option may have more to do with the social aspects of school than with the students’ math capabilities.

Mrs. Davis mentioned the challenge of motivating students to complete class work. She claimed, “More than half the boys [in the male-only class] will not show their work. I cannot look inside their head and tell them where they went wrong.” She observed, “If they feel like it’s too much content or too much effort, they won’t even try.” She expressed frustration, “They want to sit back and watch everything and not write anything down. And then when it comes time to do the assignment, they don’t understand why they don’t know what to do.”

Mrs. Davis acknowledged the challenge of motivating students to complete and submit homework was present in both single-sex and coeducational classes. Mrs. Davis speculated, “Students will only work on school work at school.” She expressed difficulty in helping students understand the concept of homework as anything not completed at school. She suggested assigned books were not being used at home by describing how students borrow textbooks daily from her, yet return a book that still appears to be brand new in May that was assigned to them in August.

Additionally, submitting assignments for a grade is another challenge in both types of classes. The counselor claimed, "Students are failing because they're not turning in work." She was astonished that students expend effort to complete assignments and then do not submit them for the grade.

Another challenge identified in both single-sex and coeducational classes pertained to general student behavior. The counselor identified the "mix of students" as a potential challenge. She described students behaving in a variety of ways, depending on the combination of students present in the class.

What are the challenges of the coeducational classes? The principal listed three challenges: determining the knowledge base of incoming students, presenting information in such an interesting way that students take ownership for learning, and managing student behavior. It could be argued that these challenges existed in all classrooms and were not limited to coeducational classes.

The counselor identified "girl drama" and social development as the prevalent challenge in the coeducational classes. She defined "girl drama" as the girls' social responses to rumors and also described scenarios in which students, boys and girls, made decisions about participating in classroom discussion and submitting assignments based on the social response from peers of the opposite sex in the coeducational classes.

Mrs. Davis and Mrs. Moore described limited verbal interactions within the coeducational classes. The former said she explained to all of her classes at the beginning of the school year her expectation for all students to respond verbally when asked a question. However, she suggested the coeducational class that was observed during this study was atypical of her coeducational classes because they did not respond to her

questioning. She assumed a lack of understanding resulted in their inhibited response. She expressed, “They may understand 100% of what we are doing, but I keep doing examples because they are not answering my questions.” Mrs. Moore suggested students in her coeducational classes did not talk or express themselves as much as the single-sex classes. She indicated, “They’re not as free to answer or show that they don’t understand something.”

Mrs. Davis attributed the students’ lack of completing and submitting homework in the coeducational classes to the level of difficulty required to complete the assignment, just as in the male-only class. She indicated the students in the coeducational classes choose to skip the problems that require more effort, like application and word problems. She stressed what a negative impact that practice had on their grades.

How are the single-sex classes evaluated? Evaluation of the single-sex classes at BMS existed as informal feedback. There was no formal evaluation process of the single-sex classes, other than the mandatory evaluation of instructors when the principal would try to observe during the period in which the single-sex classes were being taught. Informal feedback consisted of parental requests, enrollment numbers, instructor feedback, and omission. The principal credited the parents’ contentment as the driving force behind the continuation of the single-sex classes. She stated, “The parents, I think, really have driven it more than anything.”

The counselor associated the continuation of the single-sex classes to student enrollment. As long as students and parents are interested in the single-sex classes, then it will continue to be offered as an option as long as the school is able to provide it. She expressed concern about the possibility of having to remove the single-sex classes from

the master schedule if class sizes throughout the math department become too large due to budget constraints.

The counselor relied primarily on feedback from the instructors who teach the single-sex classes to determine the progress of the classes. She received verbal feedback from the instructors, expressing their desire to continue teaching the single-sex classes if they continue to be offered. In addition, she received verbal feedback from instructors in other departments who inquired about the possibility of offering single-sex classes in other departments such as English.

A lack of negative feedback from students, parents, and instructors was interpreted by the principal and the counselor as positive feedback. The principal denied receiving any objections or complaints about the single-sex classes and views the option as a "win-win." The counselor similarly remarked she had received no feedback from parents because there are no problems in the single-sex classes. However, she did describe an interaction with a parent who questioned a male instructor teaching a single-sex female class:

> "The parent was concerned because her daughter was enrolled in the girls' science class which was taught by a male teacher. She wasn't upset or anything; she just questioned why a male teacher was teaching the all-girl class. She said it was more of a curiosity issue."

The counselor did express the need to take a closer look at the single-sex classes if complaints were made.

Even though a formal process of evaluation has not been established at BMS for the single-sex classes, the principal has identified sources of information that would be

useful in determining the overall success of those classes. Aurora Learning Community Association (ALCA) was identified as a primary source of data that could be analyzed efficiently to determine the academic achievement of students as they progress each year. ALCA, funded through the U.S. Department of Education, developed a program, Comprehend, for analyzing student testing results (Aurora Learning Community Association, n.d.). She suggested comparing seventh and eighth grade test scores of students who had enrolled in the single-sex classes in the eighth grade at BMS. She also suggested tracking test scores of a core group of students who had taken the single-sex classes together during seventh and eighth grade years.

In addition to analyzing test scores, the principal identified the need to collect concrete data to determine if students are feeling more comfortable in the classroom, if the single-sex classes are sparking more interest. If the data support the goals of the single-sex classes, she expressed a willingness to request permission from the assistant superintendent for curriculum to provide additional single-sex classes in other subject areas. An English instructor has approached the counselor and expressed her desire to teach single-sex English classes, and students have requested single-sex classes for the advanced level from the counselor. These are two areas that may be considered for future single-sex classes. However, development of additional single-sex classes may be delayed because of the lack of concrete evidence that the current single-sex classes are meeting the goals originally set for them.

Mrs. Davis

How are instructional events incorporated into the single-sex classes? How are instructional events incorporated into the coeducational classes? Mrs. Davis began by

saying, “I honestly don’t think there are any differences (between the male-only class and coeducational class).” Yet, as she described how the instructional events were incorporated, some differences were identified in the following instructional events: gaining attention, recalling prior learning, presenting the content, eliciting performance, providing feedback, and assessing performance. She expressed the need for repetition when gaining attention in the male-only class; whereas, she may only need to make one attention gaining statement during the whole period in the coeducational class.

Mrs. Davis was more cautious when asking students to recall prior learning in the male-only class compared to the coeducational class. She emphasized repeatedly, “I don’t **ever** [spoken with emphasis] ask anyone to stand out.” Therefore, she avoided calling on specific students in front of the class within the male-only class.

Presentation of content was the same regarding mathematics, but the resources and techniques varied between the male-only class and the coeducational class. In the male only class, Mrs. Davis used more re-teaching and practice worksheets that came with the textbook and included worksheets from a textbook used by the basic level class because it had “more basic explanations and problems.” She also indicated she worked more problems together with the male-only class than with the coeducational class.

Class assignments used to elicit student performance were shortened occasionally to a representative sample of problems in the male-only class. Mrs. Davis reiterated she does not ask students to perform a skill in front of their peers to prevent negative feedback from the students, “No one goes to the board to work a problem [independently]…They’re brutal to each other.”

Providing feedback varied between the male-only class and the coeducational class. Mrs. Davis indicated she distributed "candy and stickers" and "words of encouragement" as positive feedback more frequently in the male-only class than in the coeducational class.

Additionally, Mrs. Davis described having lower expectations for the boys in the single-sex class, and as a result, even though they were administered the same assessment tools as the coeducational class, they were not expected to provide the same level of responses. For example, if the instructions for a problem asked them to round their answer to the nearest whole number:

> "If they got the right answer, they just didn't round, I will accept that answer. Whereas in another class, I would count it half wrong because we've specifically talked about it. I try to focus more on **did they get the concept** [spoken with emphasis]. Did they understand what I was asking them to do? And if I can get **that** [spoken with emphasis] then I'm happy with it."

She justified the difference in expectations with her perception that the boys' academic level in the single-sex class was "half-way between a regular and a basic class." She admitted to having a higher expectation of the students in the coeducational class, "They should be able to not only show me that they understand the concept, but also that they can do this concept too, round."

There did not appear to be differences incorporating some of the instructional events between the single-sex and coeducational classes: informing students of the objective, providing learning guidance, and enhancing retention and transfer. The

strategies utilized to incorporate these instructional events will be discussed in the next section.

What instructional strategies are utilized in the single-sex classes? What instructional strategies are utilized in the coeducational classes? The strategies for each instructional event will be discussed as they were utilized in the male-only class and the coeducational class.

Gaining attention. In the male-only class, strategies of voice tone and volume, repetition, proximity, and verbal statements were utilized. Mrs. Davis expressed the need to use a harsher tone and a higher volume to regain attention. She indicated the need to be repetitive in the male-only class because the boys didn't seem to understand that a general, "Let's get busy," included everyone. It seemed to her that the boys felt as if she was talking to someone else and not including them with the blanket statement. She also used proximity by standing close to the students' desks to maintain their attention. She explained that she does not typically call on individual students, but when she does, "It's because those students are not paying attention or doing what I expect them to be doing at the time, and it's just another way to redirect their attention." She specified in the male-only class she uses more direct verbal statements, "Let's get back on track…math time…let's get busy."

In the coeducational class, Mrs. Davis emphasized the lack of repetition. She explained, "Once I get the class started and we get into our routine, I don't have to gain attention again." She indicated students in the coeducational class understood instructions applied to them as a group and there was no need to repeat directives to individual students.

In both classes, Mrs. Davis manipulated the seating chart to reduce distractions and the need to gain attention. She made thoughtful decisions about the location of each student. Some students were seated in close proximity to her, while others were located in the corners to reduce the number of students in their immediate area.

Informing students of the objective. Mrs. Davis believed she informed students of the objectives consistently in the male-only and coeducational class. She relied on her elementary teaching experience by saying, "This is what we are going to do today..." In addition, she had written on the board the lesson for the day.

Recall of prior learning. Mrs. Davis indicated that sometimes she felt she was pulling information from the students when asking them to recall prior learning and at other times it seemed the students were ready and eager to share what they knew. She did not distinguish between the male-only or coeducational classes when she described strategies used to ask students to recall previous learning. However, she did emphasize multiple times she does not do anything to make one student stand out in the male-only class.

Presenting the content. Mrs. Davis mentioned the presentation of content is the same in the male-only and coeducational classes in terms of the mathematical concept being taught. However, she said she used more foundational resources that provided information and instructions in basic terms in the male-only class. She also said she provided more demonstration in the male-only class than in the coeducational class.

Providing learning guidance. Strategies to provide learning guidance were the same in the male-only and coeducational classes. The most prevalent strategy was working a variety of examples together as a class.

Eliciting performance. There were several differences between the male-only and coeducational classes in eliciting performance. Mrs. Davis provided cue words more frequently to draw information from the boys in the male-only class. Generally, the boys responded at will because she did not call on any specific boy in the class because of previous negative experiences. She believed boys who really made an effort became a target for those less interested in math. Mrs. Davis was more flexible with their responses than in the coeducational classes. She was more concerned about the boys learning how to accurately set up a problem so they could then solve it accurately than the final answer. Boys in the male-only class completed the same assignment as students in the coeducational class most of the time. However, at times she gave them an alternative assignment that was different from the assignment given to the coeducational class. The alternative assignment may have had a greater number of problems, but they were spread out and arranged so they were easier to solve. At other times she shortened assignments if the boys were taking a large amount of time working out the problems. Additionally, some of the example problems worked together as a class came directly from the assignment for the day so that when they finished the assignment, they had already completed part of the assignment. Even with this head start, "There were more zeroes and missing assignments in the all-boy class."

In the coeducational class, cueing came from students as well as Mrs. Davis. She provided some cues, but then other students responded and, as a result, provided the additional cues. She indicated students in the coeducational class did not target other individuals, so it was not an issue to call on specific students, although her preference was for all students to respond when she asked questions. Finally, students in the

coeducational class completed the whole assignment independently. They did not work part of the assignment together as a class.

Providing feedback. Mrs. Davis tried harder to provide positive feedback to the boys in the male-only class. She indicated she focused more on what the students did correctly rather than what they did incorrectly. Additionally, she said she gave more candy to the boys and placed more stickers on tests and assignments in the male-only class than in the coeducational class. She also offered words of encouragement more frequently.

In both classes, Mrs. Davis expected the students to show their work rather than just provide an answer. When they did not show their work, she wrote "no work, no credit" on the paper. She gave students the opportunity to go back to work out the problem on paper and submit it for credit, but she said they rarely took advantage of that opportunity. She estimated more students in the coeducational class than the male-only class would re-work the problems on paper. When students graded assignments as a class, she encouraged them to highlight incorrect answers so they could go back and re-work the ones they missed for credit. Again, she said very few take advantage of the opportunity. When she graded the assignments, she wrote the percentage of problems the students got correct along with the number of points they missed.

Assessing performance. Mrs. Davis expected students to grade their own classroom assignments as she provided the correct answers. However, she did not trust the boys in the male-only class to grade them accurately, so she would also grade their papers. She was more trusting of the students in the coeducational class and only "spot checked" their assignments when she put grades on them. In both classes, she indicated

they would solve problems on the assignment as a class, and when the students turned it in, they received a completion grade. She indicated both classes "**always** [spoken with emphasis] take the same tests."

Enhancing retention and transfer. Mrs. Davis indicated if students were struggling with a concept, then they would work additional examples together as a class. This was the same in the male-only and coeducational classes.

Mrs. Moore

How are instructional events incorporated into the single-sex classes? How are instructional events incorporated into the coeducational classes? Mrs. Moore repeatedly commented to indicate she did "everything the same" in the female-only and coeducational classes. After reviewing her comments and the video transcriptions, there was little evidence to indicate otherwise. She mentioned consistency as a priority. Instructional events will be discussed in terms of the strategies utilized to incorporate them.

The primary difference she identified between the female-only and coeducational classes was the higher level of interaction within the female-only class. As a result, she suggested she spent more effort getting them to "settle down" and focus than she did in the coeducational class. Additionally, she indicated she spent more time presenting the content in the female-only class, providing them with additional examples. However, as we continued discussing, she indicated the girls asked more questions that may have led to additional examples and discussion. There did not appear to be differences in the instructional events, other than gaining attention and presenting the content.

What instructional strategies are utilized in the single-sex classes? What instructional strategies are utilized in the coeducational classes? The strategies for each instructional event will be discussed as they were utilized in the female-only class and the coeducational class.

Gaining attention. Mrs. Moore utilized strategies of voice volume and tone in the female-only and coeducational classes. She suggested students turned their attention to her when she remained quiet. She would simply stop talking, and they would gradually follow suit. She said she would use a firm tone when she needed to, but it was rare because silence seemed to be effective.

Additionally, Mrs. Moore placed a "problem of the day" on the white screen from her computer to give students something productive to occupy their minds while she was taking attendance. She believed it was effective in focusing their attention to preliminary concepts related to the objective for the day.

Informing students of the objective. Mrs. Moore utilized verbal statements and visual cues to inform students of the objective in both classes. In addition to verbally informing students what she expected them to learn each day, she also utilized visual cues. She relied on the textbook to some degree to inform students of the objective they were learning from each chapter. In addition, she wrote the lesson of the day on the dry erase board.

Recall of prior learning. Mrs. Moore asked students a number of questions to determine their prior learning. She indicated she would ask questions from the previous lessons to ensure they were ready for the next step. The demands of state testing requirements were emphasized as was the importance of concept mastery.

Presenting the content. Mrs. Moore indicated she spent the majority of time in the classroom presenting the content. The use of demonstrations to assist students form associations between concepts was preferred. She described a couple of the demonstrations she has used to teach volume in which the students measured pantry items such as a rice box and used the measurements to complete their calculations. In another demonstration of volume, she asked students to compare the volume capacity of a cone and a cylinder using popcorn. She provided students with visual cues in addition to traditional instruction to help them make associations.

Mrs. Moore also provided numerous examples of problems that the class would work through together. Formulas were made available to students when working the problems because she wanted students to get used to seeing them in preparation for the state-mandated exams and to understand how to "insert the information." She continued explaining a concept until the students had no more questions and appeared to understand. Emphasis was placed upon the importance of determining whether or not an answer was reasonable as a way for students to check their work.

Mrs. Moore identified a difference between the female-only and coeducational classes being the number of examples explained in the female-only class. She believed the female-only class received more examples than the coeducational class and associated the additional examples with the number of questions being asked. Further explanation accompanied the examples. There seemed to be more questions being asked by the girls in the female-only class than by the students in the coeducational class. She wondered if it were because the students in the coeducational class did not want others to know they

did not understand, they just wanted to go on with the assignment, or were afraid. She really was not sure what the underlying cause was.

Providing learning guidance. Mrs. Moore discussed example variety, rule application in a variety of contexts, and learning tools as strategies she used to provide learning guidance. She provided students with a variety of examples from "re-teaching" worksheets and supplementary problems from the textbook and worked through the additional examples with them.

Mrs. Moore encouraged students to apply various mathematical rules when solving problems and not to rely on only one single method. For example, when taking half of a number, they could multiply .5, ½, or divide by 2. She encouraged them to share the methods they used to help other students understand there may be more than one way of solving the problem.

Mrs. Moore taught students to use a folded sheet of paper to organize notes, and she encouraged students to write notes. They had the option of using the "foldable" or traditional paper, but she emphasized note-taking as an important skill. Additionally, she encouraged students to identify cue words in the word problems they worked together.

Eliciting performance. Mrs. Moore stressed the building qualities of math, and she expected her students to increase their abilities to advance to greater difficulty levels, for example, from flat surface area to 3-dimensional objects. She provided students with examples from the textbook or practice worksheets and asked them to describe the strategy they used to solve the problems. Difficult problems were either included for bonus points or removed from the assignment completely in both classes.

Providing feedback. Mrs. Moore provided feedback on assignments by marking through incorrect responses and adding corrective feedback in the form of the correct answer in hopes that the students would understand what they did incorrectly. When students accurately completed an exceptionally difficult problem, she rewarded them with a sticker, handwritten note or smiley face, or stamp of "A+ Job!"

Assessing performance. Mrs. Moore included daily assignments and tests as formal assessments and asked numerous questions as informal assessments. The daily assignments were worth 10 points each, regardless of the number of problems. She used a set of standard index cards that she had written the total number of points possible for correctly answering a set number of problems. Students graded their own papers on occasion, but more often she asked students to exchange papers "to keep them honest." There was flexibility in the grading as long as the student's answer was "in the ballpark."

Multiple choice unit tests were administered about every four weeks, depending on the pace of instruction. Mrs. Moore explained the multiple choice option enabled students to become accustomed to deleting answer options that were not reasonable and selecting an answer from the remaining options, skills that would be a benefit during the state-mandated exams. Cumulative semester tests were given twice a year in December and in May.

Enhancing retention and transfer. Mrs. Moore assigned odd-numbered problems from the textbook for repeated practice because the students could check themselves by referring to the correct answers located in the back of the book. Problems would also be solved orally as a class to help students retain the information.

Summary

The purpose of this case study was to gain a better understanding of the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math within a public middle school. Classroom descriptions, artifact descriptions, field observations, video-recorded observations and interview data were presented categorically. Detailed classroom descriptions were provided that were consistent with multiple photographs taken of each room. Artifact descriptions included pre-enrollment information, NCLB annual report cards, video preview logs, and video reflection logs. Wide-lens observation techniques were used during classroom observations from which fieldnotes were recorded. Video-recorded observations provided in-depth documentation of instructional events and strategies as well as unexpected and complicated events that occurred during the class period. Interview questions consisted of inquiry into historical background, implementation and professional development related to single-sex classes as well as inquiry into the research questions.

CHAPTER V

DATA ANALYSIS

The previous chapter presented observational and interview data retrieved from single-sex and coeducational classes taught by the same instructor. Analyses of retrieved data are presented in this chapter. Findings related to the research questions and general themes will be discussed. Gagné's (1985) theory of instruction provided the framework for this study (See also Gagne & Medsker, 1996) and will be used to guide the discussion of instructional events and strategies.

Research Questions

What instructional events are incorporated in single-sex and coeducational classes?

Nine instructional events promote learning: gaining attention, informing students of the objective, stimulating recall prior to learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer (Gagné, 1985; Gagné & Medsker, 1996). All nine instructional events were incorporated in the two single-sex and two coeducational classes observed during this study. Strategies used to incorporate each instructional event will be discussed in the next section.

What instructional strategies do instructors who teach both single-sex and coeducational math classes use in the respective classrooms?

The most common instructional strategies used to incorporate gaining attention in single-sex and coeducational classes were calling students by name and verbal statements. Incidents of calling students by name and using verbal statements occurred almost three times higher in the male-only class compared to the coeducational class taught by the same instructor. Gurian et al. (2001) recognized that much of the attention boys received in class was disciplinary in nature. A similar pattern was observed in the female-only class, but not to the same margin of difference. The same instructional strategies to gain attention were used in the coeducational classes to a lesser frequency. Within one coeducational class, boys were called by name about five times more than girls with redirection as the most frequent purpose followed by praise and recognition. Within the other coeducational class, girls were called by name more frequently than boys for the purpose of answering questions.

There were no apparent differences in the instructional strategies used to inform students of the objective between the single-sex and coeducational classes. Combinations of verbal statements, examples, demonstrations, and visual cues were present in the four classes with verbal statements occurring most frequently and demonstrations occurring most infrequently.

The most common instructional strategy utilized to stimulate recall of prior learning in the single-sex and coeducational classes was recalling individual steps of a task. It occurred almost equally within the female-only class and the coeducational class taught by the same instructor. Recalling individual steps of a task occurred about 25% more frequently in the male-only class compared to the coeducational class taught by the same instructor. Recall of previous knowledge occurred more frequently in both single-

sex classes while recall of prerequisite rules or concepts and recall of related situations or actions occurred more frequently in both coeducational classes.

Verbal explanation was the most frequent instructional strategy used to present content in both single-sex and coeducational classes with a higher frequency occurring in the single-sex classes. Demonstration occurred most frequently in the female-only class. A combination of providing a variety of examples, emphasizing distinctive features, emphasizing rule application, and providing visual descriptions was implemented within the single-sex and coeducational classes with no distinct patterns.

Slight differences appeared in the instructional strategies used to provide learning guidance between the single-sex and coeducational classes. Combinations of examples, rule application, elaborating, estimating, and learning tools were present in the four classes. Rule application was emphasized slightly more frequently in one coeducational class compared to the male-only class taught by the same instructor while estimating and use of learning tools were emphasized more frequently in the other coeducational class compared to the female-only class taught by the same instructor.

Instructional strategies varied for eliciting performance. Nonverbal cues and student demonstration were more common in the female-only class compared to the coeducational class taught by the same instructor. Student demonstration occurred more frequently in the coeducational class compared to the male-only class taught by the same instructor.

Verbatim repetition was the most commonly used instructional strategy for providing feedback in single-sex and coeducational classes occurring more frequently in both coeducational classes. Degree of correctness was communicated more often in the

male-only class compared to the coeducational class taught by the same instructor. Affirmative paraphrase was communicated more often in the female-only class compared to the coeducational class taught by the same instructor. Interestingly, no acknowledgement of student responses was observed three times more frequently in the female-only class than in the coeducational class taught by the same instructor.

Informal assessment dominated the instructional strategies used to assess student performance in the four classes, occurring only slightly more frequently in the coeducational class compared to the female-only class taught by the same instructor. Self-assessment was encouraged more frequently in the coeducational class compared to the male-only class taught by the same instructor.

Repeated practice was the most commonly implemented instructional strategy for enhancing retention and transfer in all classes. There were no apparent differences between single-sex and coeducational classes. Observations of this instructional event were limited due to the timing of the study.

What are challenges of the single-sex and coeducational classes?

Challenges in the single-sex classes included additional effort required to focus students' attention and students' need for immediate feedback. Both instructors agreed focusing students' attention was a challenge in both of the single-sex classes. Students seemed to ask a lot of questions, both on topic and off. As a result, various strategies were used to gain and maintain attention. Mrs. Davis claimed the boys in the single-sex class were demanding in their need for immediate feedback and their interest in information pertaining to upcoming changes that may require an adjustment on their part.

She listed unwillingness to work and inadequate preparation as additional challenges in the male-only class.

Challenges presented in the coeducational classes included social drama and limited verbal interactions. The counselor identified drama associated with social development as the prevalent challenge in the coeducational classes. Both instructors described limited verbal interactions within the coeducational classes which could be related to psychosocial stress identified by Gurian et al. (2001). Additionally, Mrs. Moore identified lack of volunteer participation within the coeducational class.

Challenges present in both single-sex and coeducational classes included motivating students to complete and submit homework and managing general student behavior. Mrs. Moore did not distinguish between the female-only and coeducational classes when listing challenges. Both of her classes struggled using formulas to solve problems, specifically identifying information to enter into the formula, squaring and cubing numbers as needed, and calculating fractions.

How does the theoretical framework inform or explain the process?

Nastasi (2009) recommended an integrated approach to data analysis that included emic and etic perspectives and reflected both existing theory and participant perspectives. Gagné's (1985) theory of instruction provided the framework for this study (See also Gagné & Medsker, 1996) and was used to code data which required interpretation of participant's views and behaviors from the researcher's perspective, or etic perspective. In this regard, the framework provided a solid foundation from which emic perspectives related to instructional events were discovered.

What realities discovered in the study were not explained by the theoretical framework?

Several instructional strategies were used by the instructors in the study that were not included as examples by Gagné & Medsker (1996). As a result, additional codes for emic instructional strategies were included. Ten emic codes were added to the list of instructional strategies for gaining attention: bell tone, calling students by name, facial expression, frequency, proximity, repetition, reward, seating, verbal gesture, and verbal statement. Visual cue was added to the list of instructional strategies used to inform students of the objective. Elaborating, estimating, and referencing learning tools were added to the list of instructional strategies used to provide learning guidance. Five emic codes were added to the list of instructional strategies used to elicit performance: alternative assignment, bonus, nonverbal cue, student explanation, and verbal cue. Seven emic codes were added to the list of instructional strategies used to provide feedback: affirmative paraphrase, clarifying statement, encouraging or positive response, no acknowledgement, reward, simple acknowledgement, and verbatim repetition. Equivalent responses, modified assessment, and self-assessment were added to instructional strategies used to assess performance. There were no emic instructional strategies added to recalling prior learning, presenting content, or enhancing retention and transfer.

General Themes

More than twice as many girls than boys enrolled in the single-sex classes with 45 enrolled in the single-sex option for pre-Algebra compared to 21 boys. As a result two sections of pre-Algebra were created for the girls, while there was only one section for the boys. A similar pattern was assumed in the single-sex option for science. Of the three sections of single-sex science available, two were designated for girls and one was

designated for boys. This supports the assertion made by Jackson (2002) that girls favored the single-sex classes more than boys.

There was more interaction among students and between students and instructors in the single-sex classes compared to the coeducational classes. Interactions were more spontaneous and open-ended than interactions within the coeducational classes. This supports Rogers (2008a) observations of interactions within single-sex classes. She described broad teacher interactions with wider groups of students and increased student interactions with the teacher and other students in single-sex classes. Additionally, findings of this study support Rogers (2008b) acknowledgement that boys interact differently in single-sex classes than boys in coeducational classes with mock slaps, unknown hand gestures, and awkward facial expressions.

There was more movement in the male-only class than in the female-only and coeducational classes. The constant movement included walking from one point to another, communicating nonverbally with other boys, and fidgeting. These observations support the findings of Gurian and Stevens (2005) and Gurian et al. (2001). They emphasized the importance of frequent movement to benefit academic progress and management of impulsive behavior for boys.

Academic expectations and instructional strategies varied between the male-only and coeducational classes taught by the same teacher. The instructor did not expect the boys in the single-sex class to provide completely correct responses on homework as she did the students in the coeducational class. She stressed the need for individualized academic modifications for the boys in the single-sex class that were not necessary for

students in the coeducational class. Leonard (2006) described the increased challenge of managing male-only classes particularly when the academic ability is low.

Potential for bullying behaviors was greater in the male-only class. The instructor who taught the male-only class indicated she had modified instructional strategies for eliciting performance and discontinued calling on any one student in the single-sex class because the boys in the single-sex class had previously shown to be exceptionally critical of one another when incorrect responses were shared aloud by any one student. This data supports Dale's (1969) findings that "each sex unconsciously behaves better in front of the other group" (p. 38). He reported the presence of both females and males has a diminishing effect on the extreme forms of behavior characteristic of each group. AAUW (1998) identified boys who were targeted in the male-only classes in the absence of girls.

Girls appeared to be eager to volunteer compared to students in the coeducational class. Rogers (2008b) found girls experienced more positive interactions in the single-sex classes which may explain their willingness to readily volunteer. Girls volunteered quickly to participate in demonstrations in front of the class and to assist the instructor.

Shapka and Keating (2003) suggested that females reap more benefits of single-sex classes than males. Findings of this study would suggest fewer disciplinary interruptions occurred in the female-only class when compared to the male-only class. Fewer disciplinary interruptions would allow for more time on quality instruction.

Professional development specifically addressing the needs of students in single-sex classes was lacking. All participants acknowledged the lack of professional development for the instructors who taught single-sex classes. Research has shown the importance of providing quality professional development opportunities to promote

meaningful change when implementing single-sex classes (Cable & Spradlin, 2008; Ferrara & Ferrara, 2008; Gurian & Stevens, 2005; Leonard, 2006; Marks & Burns, 2008; Rogers, 2008b; Spielhagen, 2008c). Additionally, the findings of this study support the statement made by AAUW (1998) suggesting that creating single-sex classes without providing for teacher training or other support would probably not be enough to create meaningful change.

Evaluation of single-sex classes relied on informal methods of gathering information with no formal analysis of data. Even though BMS is in compliance with federal legislation regarding single-sex classes, formal evaluation techniques should be considered. Specific examples will be recommended in the next chapter. AAUW (1998) resisted proposed changes to Title IX legislation allowing single-sex options due to the lack of reporting requirements. Federal regulations require schools to evaluate single-sex practices every two years, but do not require them to report findings. Additionally, Friend (2007) identified implications of single-sex classes to include potential inequities caused by reinforcement of gender stereotypes or an absence of accountability for public schools choosing to implement single-sex classrooms.

Summary

In summary, differences between single-sex and coeducational classes taught by the same teacher could be seen in a variety of areas: frequency of instructional strategies used to incorporate instructional events, challenges, and general themes. Related thematic areas included professional development opportunities and evaluation of single-sex classes. Gagné's (1985) theory of instruction provided the framework for the study.

Instructional events were incorporated into single-sex and coeducational classes with variation in the frequency of instructional strategies utilized by the instructors (See Appendix E). Calling students by name and verbal statements were used to gain attention in single-sex and coeducational classes, but to a much greater frequency in the single-sex classes. Recalling individual steps of a task were common in single-sex and coeducational classes, more frequently occurring in the male-only class. Verbal explanation for presenting content was most common in single-sex and coeducational classes, occurring more often in the two single-sex classes. Verbatim repetition was the most common method of providing feedback in single-sex and coeducational classes, but to a greater frequency in the coeducational classes. Slight variation occurred in the instructional strategies used to provide learning guidance, elicit performance, and assess performance. No differences were noted between single-sex and coeducational classes in the instructional strategies used to inform students of the objective and enhance retention and transfer.

Challenges were identified in the single-sex and coeducational classes. Additional effort required to direct students' attention and to provide immediate feedback were identified as challenges in the single-sex class with additional challenges, unwillingness to work and inadequate preparation, noted in the male-only class. Social drama and verbal interactions were identified as challenges in the coeducational classes. Some challenges were associated with both single-sex and coeducational classes: motivating students to complete and submit assignments and managing general student behavior.

Thematic areas were identified throughout the study that may enhance our understanding of single-sex and coeducational classes: enrollment, interactions,

movement, bullying behaviors, academic expectations, willingness to volunteer, and disciplinary interruptions. A greater number of girls took advantage of the single-sex classes than boys. Interactions among students and between students and instructors were more prevalent in the single-sex classes. Student movement was most common in the male-only class compared to the female-only class and coeducational classes. Boys in the single-sex class had previously shown to be exceptionally critical of one another when incorrect responses were shared aloud by any one student, therefore instructional strategies for eliciting performance were modified and the instructor discontinued calling on any one student. Academic expectations were lowest in the male-only class compared to the female-only class and coeducational classes. Girls in the female-only class were most likely to volunteer to participate in demonstrations and assist the instructor. Fewer disciplinary interruptions occurred in the female-only class compared to the male-only class.

Additional thematic areas, professional development and evaluation, arose from which recommendations are offered in the next chapter. There were no professional development opportunities addressing specifically the needs of students in single-sex classes provided for instructors. Evaluation of the single-sex classes relied on informal methods of gathering information. There were no quantitative or qualitative studies conducted within BMS on academic performance, attendance, satisfaction, attitudes, behaviors, readjustment to coeducational classes, or instructional practices.

Gagné's (1985) theory of instruction provided the framework for the study and was used to code data into established categories for instructional events. Gagné & Medsker (1996) provided examples of instructional strategies from which codes were

created. Codes were added to represent emic instructional strategies used by the instructors. As a result, contributions were made to the list of instructional strategies used to incorporate instructional events.

CHAPTER VI

SUMMARY, CONCLUSIONS, BENEFITS, & RECOMMENDATIONS

Summary of the Study

The potential of single-sex classes to increase achievement dominates the discussion among educators who strive to address declines in student performance, especially in middle schools (Spielhagen, 2008c). However, there appears to be no consensus as to whether or not it is beneficial for students to be enrolled in single-sex classes within public coeducational schools (AAUW, 1998; Campbell & Wahl, 1998; Ferrara & Ferrara, 2008; Shapka & Keating, 2003). Federal legislation limited the implementation of single-sex classes within coeducational schools until 2006 when Title IX of the Education Amendments of 1972 was changed to permit public schools to establish single-sex classes within specific guidelines (AAUW, n.d.; U.S. Department of Education, 2006). It is critical to study single-sex classes within coeducational settings to ensure quality instruction for all students as schools begin to implement this option.

The purpose of this case study was to gain a better understanding of the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math within a public middle school. Ferrara (2008) received overwhelming requests from instructors for research studies in single-sex classrooms and co-educational classrooms to investigate curriculum and instruction, and gender-specific

teaching strategies. In addition, Salamone (2003) recommended further qualitative study of curriculum content, teaching style, classroom interaction, and overall climate related to single-sex classes.

Gagné's (1985) theory of instruction provided the framework for this study (See also Gagné & Medsker, 1996) in which instructional strategies were observed within the context of nine instructional events that promote learning: gaining attention, informing students of the objective, stimulating recall prior to learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer (Gagné, 1985; Gagné & Medsker, 1996). Research questions were: What instructional events are incorporated in single-sex and coeducational classes? What instructional strategies do instructors who teach both single-sex and coeducational math classes use in the respective classrooms? What are challenges of the single-sex and coeducational classes? How does the theoretical framework inform or explain the process? What realities discovered in the study were not explained by the theoretical framework?

The collective case study was conducted in a suburban public middle school that offered single-sex pre-Algebra options to students in the eighth grade. Two instructors who taught both single-sex and coeducational classes were the primary participants. The building principal and school counselors were also available to provide information throughout the study. Data collection involved classroom observations, audio-recorded interviews, video-recorded observations, and artifacts.

Data were analyzed through Gagné's (1985) theory of instruction. Additional provisions were included to ensure the trustworthiness of the study. Prolonged

engagement, persistent observation, triangulation, referential adequacy, peer debriefing, member checks, reflexive journal, thick description, purposive sampling, and the audit trail were established techniques that establish trustworthiness in naturalistic research described by Erlandson, Harris, Skipper, and Allen (1993). These techniques enable a naturalistic research study to meet criteria for credibility, transferability, dependability, and confirmability.

It was assumed the instructors who taught in single-sex classrooms had received training in the area of differentiated instruction specifically related to single-sex populations because professional development had been noted as a vital component to the success of single-sex classes (Cable & Spradlin, 2008; Ferrara & Ferrara, 2008; Gurian & Stevens, 2005; Leonard, 2006; Rogers, 2008b). However, the instructors at BMS who taught single-sex classes had not been offered any professional development opportunities that specifically addressed the needs of students within single-sex classes nor did they pursue independently information related to instructional practices.

Limitations of the study included limited number of available research sites for the study and voluntary selection of single-sex classes. BMS was the only school within 570 square miles to establish both single-sex and coeducational math classes taught by the same teacher. Title IX provisions require enrollment in single sex classrooms to be a completely voluntary option for students and their families. Shapka and Keating (2003) identified voluntary selection as a limitation in research of single-sex classrooms. In addition, they identified the lack of control used to explain pre-existing differences as an additional limitation of some studies of single-sex classrooms. A related limitation included non-equivalent group comparisons as identified by Marsh (1989).

Other proposed limitations did not prove to be problematic. Video-recorded data proved to be exceptionally informative; there were no difficulties obtaining quality data using video-recording strategies suggested by Brophy (2004) and Roschelle (2000). Inhibitive effects related to the presence of an observer or video equipment were not observed. Personal biases and expectations, emotional states, or politics did not seem to interfere with the collection of interview data.

Summary of the Findings

The findings of this study indicated some differences and similarities between single-sex and coeducational classes taught by the same teacher in a variety of areas: frequency of instructional strategies used to incorporate instructional events, challenges, and general themes. Related thematic areas included professional development opportunities and evaluation of single-sex classes.

Instructional events were incorporated into single-sex and coeducational classes with variation in the frequency of instructional strategies utilized by the instructors (See Appendix E). Calling students by name and verbal statements were used to gain attention in single-sex and coeducational classes, but to a much greater frequency in the single-sex classes. Verbal statements used to gain attention were most common in the male-only class. Recalling individual steps of a task were common in single-sex and coeducational classes, more frequently occurring in the male-only class. Verbal explanation for presenting content was most common in single-sex and coeducational classes, occurring more often in the two single-sex classes. Verbatim repetition was the most common method of providing feedback in single-sex and coeducational classes, but to a greater frequency in the coeducational classes. Informal assessment dominated the instructional

strategies used to assess student performance in single-sex and coeducational classes. Self-assessment was more common in the coeducational class than in the male-only class taught by the same instructor. Slight variation occurred in the instructional strategies used to provide learning guidance and elicit performance. No differences were noted between single-sex and coeducational classes where verbal statements were used to inform students of the objective and repeated practice was used to enhance retention and transfer.

Challenges were identified in the single-sex and coeducational classes. Additional effort required to direct students' attention and to provide immediate feedback were identified as challenges in the single-sex class with additional challenges, unwillingness to work and inadequate preparation, noted in the male-only class. Social drama and verbal interactions were identified as challenges in the coeducational classes. Some challenges were associated with both single-sex and coeducational classes: motivating students to complete and submit assignments and managing general student behavior.

Thematic areas were identified throughout the study that may further our understanding of single-sex and coeducational classes: enrollment, interactions, movement, bullying behaviors, academic expectations, willingness to volunteer, and disciplinary interruptions. A greater number of girls took advantage of the single-sex classes than boys. Interactions among students and between students and instructors were more prevalent in the single-sex classes. Student movement was most common in the male-only class compared to the female-only class and coeducational classes. Boys in the male-only class were exceptionally critical of one another when any one student was called upon, provided an inaccurate response, or otherwise brought attention to oneself. Academic expectations were lowest in the male-only class compared to the female-only

class and coeducational classes. Girls in the female-only class were most likely to volunteer to participate in demonstrations and assist the instructor. Fewer disciplinary interruptions occurred in the female-only class compared to the male-only class.

Additional thematic areas, professional development and evaluation, were identified. There was no professional development specifically addressing the needs of students in single-sex classes provided for instructors. Evaluation of the single-sex classes relied solely on informal methods of gathering information.

Gagné's (1985) theory of instruction provided the framework for the study and was used to code data into established categories for instructional events. Gagné & Medsker (1996) provided examples of instructional strategies from which codes were created. Codes were added to represent emic instructional strategies used by the instructors. As a result, contributions were made to the list of instructional strategies used to incorporate instructional events.

Conclusions

Coeducational schools that implement single-sex classes are likely to discover a larger numbers of girls and their parents interested in the single-sex option resulting in the need for more sections of female-only classes. Course demand is an important consideration when determining instructor availability.

Instructors who teach single-sex and coeducational classes may assume there are no instructional differences when differences exist. Both instructors in this study declared there were no instructional differences between the single-sex and coeducational classes, yet differences were identified. Professional development that addresses the specific needs of students in single-sex classes may enlighten instructors to subtle differences.

Students enrolled in single-sex classes are more likely to interact with the teacher and with their peers. Interactions within single-sex classes appeared to be open-ended and spontaneous compared to the purposeful and limited interactions in the coeducational classes.

Benefits

Findings of this study contribute to the body of research in the United States. Riordan based his support of changes to Title IX regulations (Jost, 2002) on a need for additional research. He viewed the change in Title IX requirements as a step toward increasing the number of single-sex schools and classrooms, thus increasing the opportunities for conducting research that would lead to a better understanding of the effectiveness of single-sex schools and classrooms.

This study contributes to the body of research by adding to the few studies that include research of single-sex classes within coeducational schools, particularly where the same instructor teaches both types of classes. Such a setting reduces the variability that may occur when studying single-sex and coeducational classes taught by different instructors who have variable experiences.

Findings of this study do not contribute to Gagné's (1985) theory of instruction as the original instructional events remain unchanged. However, the findings may contribute to the examples of instructional strategies provided by Gagné and Medsker (1996) as these strategies are implemented in single-sex and coeducational classes. Codes for instructional strategies used by the instructors in this study that were not included by Gagné and Medsker (1996) were added as emic codes (See Appendix D). As a result,

contributions were made to the list of examples that represent instructional strategies used to incorporate instructional events.

Findings of this study indicate a need for sound policy development at the local, state, and national levels regarding evaluation of single-sex classes. Current policy lacks a requirement for reporting evaluation results which may allow single-sex classes to be implemented and maintained with minimal effort and knowledge thus increasing the potential for inequities to occur. There is growing interest in the development of single-sex classrooms now that the prohibitive regulations of Title IX have been changed and additional research is needed to guide sound policy development regarding evaluation.

Recommendations

Practice

Research has shown the importance of providing quality professional development opportunities to promote meaningful change when implementing single-sex classes (Cable & Spradlin, 2008; Ferrara & Ferrara, 2008; Gurian & Stevens, 2005; Leonard, 2006; Marks & Burns, 2008; Rogers, 2008b; Spielhagen, 2008c). Findings of this study identified a lack of professional development specifically addressing the needs of students in single-sex classes. It is recommended that quality professional development opportunities specifically addressing the needs of students in single-sex classes be provided for the instructors who teach these classes. Similar professional development for administrators and counselors would facilitate their understanding of the needs within the single-sex classes. Even if funding were not available to attend regional, national, or international conferences, such as those offered by the National Association for Single Sex Public Education, book study groups can be very informative and economical.

Frequently asked questions about forming a book study group may be found on the Eye on Education website (n.d.).

Even though BMS is in compliance with federal legislation regarding single-sex classes, formal evaluation techniques should be considered. Evaluation of single-sex classes relied on informal methods of gathering information with no formal analysis of data. AAUW (1998) resisted proposed changes to Title IX legislation allowing single-sex options due to the lack of reporting requirements. Federal regulations require schools to evaluate single-sex practices every two years, but do not require them to report findings. It is recommended that formal evaluations be conducted of the single-sex classes and presented to the district administration, parents, and the community for accountability.

It is recommended that single-sex classes not be expanded at BMS until specific criteria have been met. First, formal evaluation of the current single-sex and coeducational classes are necessary and required at least every two years (Title IX, 2007). Quantitative studies are recommended for measuring academic achievement, attendance, and behavior of students enrolled in the single-sex classes, while qualitative studies are recommended for determining student satisfaction, attitudes, and readjustment to coeducational classes after completing a single-sex class. Second, in order to have a reasonable expectation of meaningful change, professional development opportunities that offer training in the specific needs of students in single-sex classes are recommended for current instructors of single-sex classes (AAUW, 1998).

Even if these two criteria are met, it is recommended that school leaders proceed with caution as they make critical decisions regarding single-sex classes. Friend (2007) advised school leaders to consider the historical legacy of gender and racial inequities

found in separate educational settings before creating single-sex classes. Huget and Régner (2007) cautioned school leaders to consider the gains in student performance in the classroom versus the tension and discrimination outside the classroom when determining the appropriateness of single-sex classes. Hyde and Lindberg (2007) cautioned educators about arguments that rely on assumptions of large psychological differences between males and females. They claim that males and females are very similar on most relevant variables.

Teaching and learning are complex activities that are isolated and private which limits instructors in their opportunities to view and discuss instructional strategies. Sherin (2004) found that teachers are motivated by watching video-recordings of classroom instruction, and that video-recordings are useful for teacher development. The combination of video-recording with video preview and reflection logs is recommended for teacher development.

Further Research

Additional research is recommended to understand better what is occurring within single-sex classrooms in the areas of interactions, bullying patterns, and questioning strategies. Findings of this study indicated a higher frequency of interactions within single-sex classes. Additional research is recommended to identify and understand patterns of these interactions. Sadker et al. (1982) developed INTERSECT: Interactions for Sex Equity in Classroom Teaching, an instrument used to identify patterns of potential bias or equity in the ways instructors and students interact with one another. It was field tested in 4^{th} grade, 6^{th} grade, and 8^{th} grade classrooms. INTERSECT is

recommended for use by researchers or practitioners who are committed to learning how to use the instrument efficiently in a classroom setting.

Spielhagen (2008b) suggested further analysis may reveal a pattern of bullying emerging over time in single-sex classes, particularly in the male-only class. Findings of this study would support the need for such analysis. The instructor who taught the male-only class claimed previous behavior between the male students was "brutal" before she modified instructional practices, such as calling on individual students and reducing the possibility that any student could identify the inaccurate response of another student.

Jackson (2002) asserted girls favored single-sex classes more than boys. Data in the current study supported her assertion. Additional research is recommended to better understand the characteristics, motivations, and interests of parents who opt for single-sex options.

It is recommended to research questioning strategies used in single-sex and coeducational classes. Moore (2009) proposed two classification systems used to identify levels of questions. In addition, a revised version of Bloom's (1956) Taxonomy could be used as an analytical framework to determine the cognitive levels of questions asked in the single-sex and coeducational classes (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001).

Salamone (2003) recommended further qualitative study of curriculum content, teaching style, classroom interaction, and overall climate related to single-sex classes. Replication of the current study is recommended that may include other subject areas or different theoretical frameworks.

Final Thoughts

There is political risk associated with researching such a controversial subject, both as researcher and as participant. As researcher and employee of BSD, I found it difficult to report findings that indicated inequitable educational practices in the male-only class. Participant decisions analyzed from a third party perspective become open to scrutiny. I believe the differences in instructional events and strategies that occurred between the single-sex and coeducational classes are a direct result of a lack of professional development that address the needs of students in single-sex classes and a lack of formal evaluation of single-sex classes.

Participants in the study are not solely responsible for inequities that may have occurred in the single-sex classes. Much of the responsibility lies with policymakers at the local, state, and federal levels. Decisions to establish separate educational settings based on gender should be considered in light of the nation's history of educational inequities. Considerable analysis of multiple data sources should be conducted at the local level to identify measurable goals to be achieved by single-sex classes before they are implemented. Professional development directly related to single-sex classes or the identified goals should be provided to instructors before they are expected to teach single-sex classes. There was no useful information found on the state department website addressing the option of single-sex classes. The federal government has allowed the establishment of single-sex classes without providing evaluation guidelines or requiring a report of evaluation findings, which is problematic.

Formal assessments of single-sex classes must be conducted to identify progress toward measurable goals. If progress is not made, then discontinuing or changing the

format of single-sex classes may be necessary. If formal evaluations are not conducted and results are not reported, not only may goals go unattained, but inequities in educational practices may occur without notice.

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APPENDICES

APPENDIX A

VIDEO PREVIEW LOG

Teacher Initials: _____ Date of Lesson: _____

Grade Level: _____ Period: _____

Check One: _____ Coeducational _____ Single-Sex Female _____ Single-Sex Male

Topic of Lesson:

Objective(s):

Check Instructional Events incorporated into this lesson and describe the Instructional Strategies that are utilized (check only those that apply to today's lesson):

☐ Gaining Attention
Describe the use of abrupt stimulus change…

☐ Informing Students of the Objective
Describe how students will be informed as to what they will be able to do after learning…

☐ Stimulating Recall of Prior Learning
Describe how students will be asked to recall previously learned knowledge/skills…

☐ Presenting the Content
Describe the distinctive features of content presentation…

☐ Providing Learning Guidance
Describe how the content is made meaningful…

☐ Eliciting Performance
Describe how students will be asked to perform the learned content…

☐ Providing Feedback
Describe how informative feedback will be provided to students…

☐ Assessing Performance
Describe how performance will be assessed…

☐ Enhancing Retention and Transfer
Describe how varied practice and reviews are provided…

Describe Anticipated Challenges (Use the back of this sheet as needed):

Note. Instructional events are from Gagné (1985).

APPENDIX B

VIDEO REFLECTION LOG

Teacher Initials: _____ Date of Lesson: _____

Grade Level: _____ Period: _____

Check One: _____ Coeducational _____ Single-Sex Female _____ Single-Sex Male

Topic of Lesson:

Objective(s):

Check Instructional Events incorporated into this lesson and describe the Instructional Strategies that are utilized (check only those that apply to today's lesson):

☐ Gaining Attention
Describe the use of abrupt stimulus change…

☐ Informing Students of the Objective
Describe how students were informed as to what they will be able to do after learning…

☐ Stimulating Recall of Prior Learning
Describe how students were asked to recall previously learned knowledge/skills…

☐ Presenting the Content
Describe the distinctive features of content presentation…

☐ Providing Learning Guidance
Describe how the content was made meaningful…

☐ Eliciting Performance
Describe how students were asked to perform the learned content…

☐ Providing Feedback
Describe how informative feedback was provided to students…

☐ Assessing Performance
Describe how performance was assessed…

☐ Enhancing Retention and Transfer
Describe how varied practice and reviews were provided…

Describe Experienced Challenges (Use the back of this sheet as needed):

Note. Instructional events are from Gagné (1985).

APPENDIX C

INTERVIEW QUESTIONS

Principal:

1. What is the local history of single-sex classrooms within the Bedford School District?
2. How were single-sex classrooms implemented within Bedford Middle School?
3. What professional development opportunities, if any, have been provided for instructors who teach single-sex classes?
4. What are the challenges of the single-sex classes?
5. What are the challenges of the coeducational classes?
6. How are the single-sex classes evaluated?

Counselor:

1. What is the local history of single-sex classrooms within the Bedford School District?
2. How were single-sex classrooms implemented within Bedford Middle School?
3. What professional development opportunities, if any, have been provided for instructors who teach single-sex classes?
4. What are the challenges of the single-sex classes?
5. What are the challenges of the coeducational classes?
6. How are the single-sex classes evaluated?

Instructors:

1. What professional development opportunities, if any, have been provided for instructors who teach single-sex classes?
2. What are the challenges of the single-sex classes?
3. What are the challenges of the coeducational classes?
4. How are instructional events incorporated in the single-sex classes?
5. How are instructional events incorporated in the coeducational classes?
6. What instructional strategies are utilized in the single-sex classes?
7. What instructional strategies are utilized in the coeducational classes?
8. How are the single-sex classes evaluated?

APPENDIX D

CODE LIST

Case:

MA – Single-Sex Male with Mrs. Davis
FB – Single-Sex Female with Mrs. Moore
CA – Coeducational with Mrs. Davis
CB – Coeducational with Mrs. Moore

Source:

A – Teacher A (Mrs. Davis) Interview
B – Teacher B (Mrs. Moore) Interview
C – Counselor Interview
P – Principal Interview
FMA I & II – Fieldnotes, Single-Sex Male, Teacher A
FFB I & II – Fieldnotes, Single-Sex Female, Teacher B
FCA I & II – Fieldnotes, Coeducational, Teacher A
FCB I & II – Fieldnotes, Coeducational, Teacher B
VMA I, II, & III – Video-recording, Single-Sex Male, Teacher A
VFB I, II, & III – Video-recording, Single-Sex Female, Teacher B
VCA I, II, & III – Video-recording, Coeducational, Teacher A
VCB I, II, & III – Video-recording, Coeducational, Teacher B
*Artifacts will be specified.

Related to Research Questions:

Instructional Events	Instructional Strategies
E1 – Gaining Attention (Abrupt stimulus change)	S1 – Gestures (Body Language) S2 – Voice Tone/Volume S3 – Audio-Visual Experience S4 – Unusual Event SX – Bell Tone SX – Calling Student's Name SX – Facial Expression SX – Frequency SX – Proximity SX – Repetition SX – Reward SX – Seating SX – Verbal Gesture SX – Verbal Statement
E2 – Informing Students of the Objective (Tell learners what they will be able to do after learning)	S1 – Verbal Statements

CODE LIST

S2 – Examples
S3 – Demonstrations
SX –Visual

E3 – Recall of Prior Learning
(Ask for recall of previously learned knowledge or skills)
S1 – Pre-Requisite Rules/Concepts
S2 – Previous Knowledge
S3 – Related Situations/Actions
S4 – Individual Steps of a Task

E4 – Presenting the Content
(Display the content with distinctive features)
S1 – Verbal Explanation/Description
S2 – Demonstration (instruction)
S3 – Variety of Examples
S4 – Emphasis on Distinctive Features
S5 – Emphasis on Rule Application
S6 – Visual Explanation/Description

E5 – Providing Learning Guidance
(Suggest a meaningful organization)
S1 – Variety of Examples/Non-Examples
S2 – Rule Application in Variety of Contexts
SX – Elaborating
SX – Estimating
SX – Learning Tool

E6 – Eliciting Performance
(Ask learner to perform)
S1 – Student Demonstration
S2 – Fading Cues
S3 – Progression of Quality Standards
S4 – Progression of Quantity Standards
S5 – Advancement of Difficulty Level
S6 – Backward Chaining
SX – Alternative Assignment
SX – Bonus
SX – Nonverbal Cue
SX – Student Explanation
SX – Verbal Cue

APPENDIX D (continued)

CODE LIST

E7 – Providing Feedback
(Give informative feedback)
- S1 – Degree Correctness
- S2 – Degree Incorrectness
- S3 – Corrective Feedback
- SX – Affirmative Paraphrase
- SX – Clarifying Statement
- SX – Encouraging/Positive Response
- SX – No Acknowledgment
- SX – Reward
- SX – Simple Acknowledgment
- SX – Verbatim Repetition

E8 – Assessing Performance
(Require additional learner performance with feedback)
- S1 – Formal Assessment
- S2 – Informal Assessment
- SX – Equivalent Responses
- SX – Modified Assessment
- SX – Self-Assessment Opportunity (I.D.)

E9 – Enhancing Retention and Transfer
(Provide varied practice and spaced reviews)
- S1 – Repeated Practice
- S2 – Practice Variety

C – Challenges
FE – Framework Explanation
FL – Framework Limitation

Related to Additional Questions and Themes:

H – Local History
I – Implementation
PD – Professional Development
EV – Evaluation
IN – Interactions
EN – Enrollment
CR – Critical
EX – Expectations
V – Volunteer
D – Disciplinary Interruptions
M – Movement

Note. Instructional events are from Gagné (1985). Strategies are from examples of "instructional techniques" provided in Gagné & Medsker (1996) with the exception of those coded "SX." "SX" codes were used to represent emic instructional strategies identified during the study.

APPENDIX E

INCIDENCE OF OBSERVED INSTRUCTIONAL EVENTS AND STRATEGIES

Instructional Event	Mrs. Davis		Mrs. Moore	
and Strategy	Male-Only	Coed	Female-Only	Coed
E1S1	7	1	7	2
E1S2	11	0	5	4
E1S3	0	2	5	5
E1S4	0	0	0	0
E1SX Bell Tone	0	1	0	0
E1SX Student Name	86	31	96	86
E1SX Facial Exp	1	0	2	1
E1SX Repetition	2	0	0	0
E1SX Reward	2	2	0	0
E1SX Verbal Gest	1	0	15	0
E1SX Verbal State	85	26	31	12
E2S1	9	10	9	12
E2S2	2	1	1	3
E2S3	0	0	1	1
E2SX Visual	5	5	7	6
E3S1	8	10	27	39

APPENDIX E (continued)

INCIDENCE OF OBSERVED INSTRUCTIONAL EVENTS AND STRATEGIES

Instructional Event	Mrs. Davis		Mrs. Moore	
and Strategy	Male-Only	Coed	Female-Only	Coed
E3S2	4	1	40	24
E3S3	3	7	16	30
E3S4	78	53	125	124
E4S1	69	52	55	32
E4S2	8	7	30	23
E4S3	9	9	14	11
E4S4	2	3	14	10
E4S5	5	3	6	7
E4S6	0	0	1	3
E5S1	4	3	15	16
E5S2	4	10	12	10
E5SX Elab	2	0	10	10
E5SX Est	0	0	10	14
E5SX Learn Tool	6	5	9	14
E6S1	5	10	33	25
E6S2	2	0	4	4
E6S3	0	0	0	0
E6S4	0	0	0	0

APPENDIX E (continued)

INCIDENCE OF OBSERVED INSTRUCTIONAL EVENTS AND STRATEGIES

Instructional Event	Mrs. Davis		Mrs. Moore	
and Strategy	Male-Only	Coed	Female-Only	Coed
E6S5	0	0	0	0
E6S6	1	0	2	1
E6SX Bonus	0	0	3	5
E6SX Nonverb Cue	1	0	43	31
E6SX Student Exp	1	1	2	5
E6SX Verbal Cue	0	0	8	0
E7S1	41	23	49	51
E7S2	11	5	2	6
E7S3	27	3	37	28
E7SX Aff Para	37	36	72	53
E7SX Clar Stmnt	0	1	5	2
E7SX Enc/Pos	21	12	22	23
E7SX No Ack	0	0	12	4
E7SX Reward	4	0	0	0
E7SX Simple Ack	0	0	4	0
E7SX Verb Rep	28	44	189	247
E8S1	15	14	8	5
E8S2	103	113	131	191
E8SX Equiv Resp	5	2	1	2

APPENDIX E (continued)

INCIDENCE OF OBSERVED INSTRUCTIONAL EVENTS AND STRATEGIES

Instructional Event	Mrs. Davis		Mrs. Moore	
and Strategy	Male-Only	Coed	Female-Only	Coed
E8SX Self-Assess	8	18	4	5
E9S1	5	3	3	4
E9S2	3	2	0	1

Note: From fieldnotes and video-recorded data only.

APPENDIX F

BRIEF SUMMARY OF FINDINGS

Instr. Events	**Boys Only**	**Coed**	**Girls Only**	**Coed**
Gaining Attention	Calling Students by Name & Verbal Statements	Lesser Degree	Calling Students by Name	Lesser Degree
Informing Students of Obj.	Verbal Statements	No Differences	No Differences	No Differences
Recall of Prior Learning	Indiv. Steps of Task	Lesser Degree	Lesser Degree	Lesser Degree
Presenting Content	Verbal Explanation	Lesser Degree	Verbal Explanation	Lesser Degree
Providing Learning Guidance	Variation	Variation	Variation	Variation
Eliciting Performance	Variation	Variation	Variation	Variation
Providing Feedback	Lesser Degree	Verbatim Repetition	Lesser Degree	Verbatim Repetition
Assessing Performance	Informal Assess	No Difference	Lesser Degree	Informal Assess
	Lesser Degree	Self-Assess		
Enhancing Retention & Transfer	Repeated Practice	No Differences	No Differences	No Differences
Challenges	Redirection	Social Drama	Redirection	Social Drama
	Immed. Feedback	Fewer Verbal Interactions	Immed. Feedback	Fewer Verbal Interactions
	Unwilling			
	Inadequate Preparation			
	Motivation	Motivation	Motivation	Motivation
	Assignment Completion & Submission	Assignment Completion & Submission	Assignment Completion & Submission	Assignment Completion & Submission
	Gen. Student Behavior	Gen. Student Behavior	Gen. Student Behavior	Gen. Student Behavior
Themes	More Interactions		More Interactions	
General	Physical Movement		Higher Enrollment #s	
Informal Eval	Critical		Volunteer	
No Specific Professional Development	Different Expectations		Fewer Disciplinary Interruptions	

VITAE

Leslie K. Clark

Candidate for the Degree of

Doctor of Education

Dissertation: INSTRUCTIONAL EVENTS AND STRATEGIES WITHIN EIGHTH GRADE SINGLE-SEX AND COEDUCATIONAL MATH CLASSROOMS

Major Field: Educational Administration

Biographical:

Personal Data: Born in Tulsa, Oklahoma, January 20, 1969, the daughter of Merlyn and Verna Maulsby. Married to Dan Clark.

Education: Graduated from Collinsville High School, Collinsville, Oklahoma, May 1987; earned B.S.Ed. in Science Education, Northeastern State University, Tahlequah, Oklahoma, 1993; completed teacher certification requirements in the areas of Anatomy/Physiology, Biology, Botany, Earth Science, General Science, and Zoology; earned M.Ed. in School Counseling, Northeastern State University, Tahlequah, Oklahoma, 1997; completed certification requirements for secondary counselor, 1997; completed certification requirements for secondary principal, 2001; completed certification requirements for superintendent, 2005; completed Ed.D. program in School Administration at Oklahoma State University, Stillwater, Oklahoma, December 2010.

Experience: Employed as a secondary Science teacher at Owasso Public Schools, Owasso, Oklahoma, January 1993 to May 2002; served 3 years as varsity softball assistant coach and 4 years as student council advisor; selected as Owasso High School Teacher of the Year, 1998; employed as a school counselor at Owasso High School, August 2002 to May 2009; nominated for State Counselor of the Year, 2006; employed as an assistant principal at Owasso High School, June 2009 to present.

Name: Leslie K. Clark Date of Degree: December, 2010

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: INSTRUCTIONAL EVENTS AND STRATEGIES WITHIN EIGHTH GRADE SINGLE-SEX AND COEDUCATIONAL MATH CLASSROOMS

Pages in Study: 194 Candidate for the Degree of Doctor of Education

Major Field: Educational Administration

Scope and Method of Study:

The purpose of this case study was to gain a better understanding of the instructional events and strategies in classrooms where the instructors taught both single-sex and coeducational math within a public middle school. Gagné's (1985) theory of instruction provided the framework and informed the findings of this study (See also Gagné & Medsker, 1996) in which instructional strategies were observed within the context of nine instructional events that promote learning: gaining attention, informing students of the objective, stimulating recall prior to learning, presenting the content, providing learning guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer. Data collection included classroom observations, audio-taped interviews, video-recorded observations and artifacts.

Findings and Conclusions:

The findings of this study indicated some differences and similarities between single-sex and coeducational classes taught by the same teacher in a variety of areas: frequency of instructional strategies used to incorporate instructional events, challenges, and general themes. Thematic areas were identified throughout the study that may further our understanding of single-sex and coeducational classes: enrollment, interactions, movement, bullying behaviors, academic expectations, willingness to volunteer, and disciplinary interruptions. Related thematic areas included professional development opportunities and evaluation of single-sex classes.

Instructors who teach single-sex and coeducational classes may assume there are no instructional differences when differences exist. Both instructors in this study declared there were no instructional differences between the single-sex and coeducational classes, yet differences were identified. Professional development that addresses the specific needs of students in single-sex classes may enlighten instructors to subtle differences. Students enrolled in single-sex classes are more likely to interact with the teacher and with their peers. Interactions within single-sex classes appeared to be open-ended and spontaneous compared to the purposeful and limited interactions in the coeducational classes.

ADVISOR'S APPROVAL: Dr. Kenneth Stern