Science and Mathematics Education Centre

The Effect of Hands-on Interdisciplinary Mathematics Activities on Mathematics Achievement and Attitudes: A Study of At-Risk Students Detained in a Juvenile Justice Facility

Loris Carter

This thesis is presented for the Degree of

Doctor of Philosophy

of

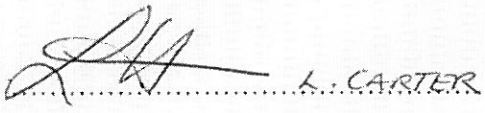
Curtin University of Technology

October 2008

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

Signature:  L. CARTER

Date: 22.08.08

ABSTRACT

A variety of instructional strategies is necessary to ensure that all learning styles are considered in an effective classroom environment. This study investigated whether or not hands-on activities incorporated into the mathematics curriculum results in significant improvement in attitude towards and achievement in mathematics for students detained in a Juvenile Justice Facility. The sample, consisting of 50 male students aged 13 to 18, completed a Basic Achievement Skills Inventory (BASI) test and the Test of Mathematics-Related Attitudes (TOMRA) survey. Pretest and posttest scores were compared to determine whether or not there was a statistically significant improvement in attitude and achievement as a result of incorporating these hands-on activities.

This study is unique in two ways. Firstly, it provides current educational data on strategies used with students in the only level 6 facility in South Florida in the Department of Juvenile Justice. Secondly, the study provides examples of successful strategies used in a multi-grade level mathematics classroom. The study revealed that the BASI and TOMRA were valid and reliable instruments for assessing student classroom achievement in and attitudes towards mathematics, respectively.

The contributions and significance of this study are that it provides data to support the importance of integrating hands-on activities into the curriculum for at-risk students that are detained in a Juvenile Justice Facility. National and international comparisons of at-risk students can be made for male teenaged youths. This study is useful because it could be replicated to consider female at-risk students detained in a Juvenile Justice Facility.

DEDICATION

This thesis is dedicated to my family and my friends. My entire village embraced me and encouraged me as I embarked on this journey. Emotionally and spiritually, this journey was an adventurous one. My children kept me sane and grounded throughout the entire experience.

To my first born son, Tiovanni, you are an example of what a strong determined young man is. My efforts are an example of what can be accomplished with hard work. Continue to work hard in your educational pursuits and your success is guaranteed!

Torran, my quiet hero, I know that you are very observant. Your adventure is just beginning. I want you to see the results of higher education. Take purposeful time to accomplish your goal. Remember that completion of your journey will be your true joy!

Tyrie, my third son; your charm, wit and intelligence provides you with the potential to do great things and I know that you will. Like your siblings, I was encouraged by you. However only you provided me with the greatest foot massage a mother could ask for when my days were too exhausting to imagine. Let your high school career continue to help mould you into another success story that the world can admire.

My beautiful daughter Tanae, I longed for a girl and I received a gift in you. Half of your life, I have been consumed in preparation of this document. Your patience, understanding and support of me made me smile and endure the endless hours of work.

God gave me all four of you and I am so thankful. I hope my life has inspired all of you to pursue the extra ordinary.

Carter, your support from a distance can never be replaced. I know how you feel and appreciate everything!

To Charles and Lisa, you always told me how “proud” you both are of me every step of the way. Thank you for the consistent support!

To Lorna, you inspired and still inspire me with your independence and wit. Thank you for being the ear of support and the voice of encouragement from the very beginning.

ACKNOWLEDGEMENTS

There are several people without whose help this thesis would not have reached completion.

My great appreciation and admiration is extended to my supervisor and friend, Dr. David Treagust. Your guidance, patience, time and assistance were essential to my successful completion of my studies.

I would also like to thank Dr. Chandrasegaran for his assistance regarding my data analysis. Your timely response to my many inquires provided invaluable support.

I would like to thank Dr. Karen Helding who encouraged me to embark on this journey and provided me with guidance and support in every area of the study.

Lastly, I would like to thank the participants in my study. You were curious, respectful, and honest as you shared your opinions. Your unbiased, candid, responses will make the difference for years to come.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Chapter 1
RATIONALE AND BACKGROUND

1.0 Overview of the Chapter

This chapter outlines the problem and rationale for the study, the need for hands-on instruction, the theoretical framework, the sample, purpose of the study, the research questions and provides an overview of the research design. This chapter is divided into nine sections. Section 1.1 describes the research problem and questions. Section 1.2 describes the impact of hands-on activities on student learning and Section 1.3 continues with the theoretical framework. A description of the student sample was provided in Section 1.4 and the purpose of the study was described in Section 1.5. Research questions were presented in Section 1.6 and an overview of the research design was described in Section 1.7. The limitations of the study comprised Section 1.8 and the organization of the thesis finalized the chapter in Section 1.9.

1.1 The Problem and Rationale for the Study

This study investigates whether or not hands-on mathematics activities incorporated into all aspects of the mathematics curriculum for students in a juvenile justice facility results in significant improvement in the students' achievement in and attitudes towards mathematics.

Statewide concerns exist regarding the inability of American students to pass basic skills mathematics tests even though nation-wide results indicate some progress in mathematics when comparing the performance of students in the United States with students in 38 other countries (TIMSS, 1999). The TIMSS report of 1999 revealed that the United States and Italy dropped significantly below the international average at the 8th grade level. Educators blame this lack of success on the student truancy rate, which seems to increase exponentially once a student enters middle school when student interests tend to shift towards more pleasurable personal experiences.

Implementing hands-on mathematics activities was an attempt to merge interest and academics. Dewey (1900) believed that, through hands-on activities, students could combine intellectual stimulation with activities that expanded learning. The use of interdisciplinary hands-on activities in mathematics classes is intended to provide

students with a connection to other classes in the curriculum as well as to provide a relevance to everyday life (Day, 2000). Consequently, the research was designed to investigate whether or not there was a significant improvement in student's achievement in and attitudes towards mathematics when hands-on activities were incorporated in the mathematics curriculum in a juvenile justice facility. According to Ainley, Batten, and Miller (1984b), schools that offer hands-on learning programs demonstrate higher graduation rates than schools which focus on lecture-and-examination subjects geared to university entrance.

1.2 The Need for Hands-on Instruction

In a recent study by Day (2000), a sample of 780 at-risk middle school students supported the need for hands-on instruction. The town of 50,000 housed these students where the ethnic make-up consisted of 56% White, 35% Black, 6% Hispanic, and 3% Asian. From this population, 46% qualified for the free or reduced school lunch program which supports families with financial needs. In this juvenile justice facility, 90% of the students qualified for financial assistance. Furthermore, the resounding response from the at-risk middle school students to hands-on activities was "I have more fun in this class because it is not boring, we get to build things". The evaluator stated that students expressed a higher level of interest and motivation as compared to their other classes. One conclusion was that hands-on activities were a "major strength of the program towards engaging and teaching students at the research site". As a result of the use of hands-on labs, students seemed to enjoy making decisions and rarely engaged in disruptive behaviours furthering the need to provide hands-on instruction to the residents of a juvenile justice facility.

When researching how the brain processes and organises information, Day (2002) reported that the brain may resist learning partial facts that are presented in isolation and that learning is believed to occur faster and more thoroughly when material is presented in meaningful contexts. The research reported in this thesis was a case study that investigated whether the integration of hands-on mathematics activities with other school subjects affected student's attitudes to and scores in mathematics. The students in this juvenile justice facility were designated at risk and were taught in a multi-level remedial environment that also provides their accommodation.

Hands-on activities, which are an alternative teaching method to lectures, may provide greater retention of information leading to greater student understanding of the prerequisites of the mathematics course as well as improved attitudes towards mathematics. Gokhale's (1996) hands-on learning theory was explored and investigated at this juvenile justice facility. Gokhale defined the hands-on learning theory as "students learn as a result of doing or experiencing things in the world, and learning occurs when mental activity is suffused with physical activity" (p.38). By taking into account Gokhale's learning theory at this facility, it may be possible to provide data to support or refute his documented practice, taking into account the various backgrounds and mental abilities that the students at this facility possessed.

Researchers have noted that when students are actively involved in the learning process, their learning improves (Breslow, 1999). Both the American Statistical Association (ASA) and the Mathematics Association of America (MAA) have recommended that teachers encourage active learning in their classrooms. Active learning has been defined as studying ideas, solving problems and engagement in some activity that encourages students to think and apply what is learned (Modell & Michael, 1993; Siberman, 1996). It has also been called "interactive engagement" by Hake (1998) who writes that the methods are "designed in part to promote conceptual understanding through interactive engagement of students in hands-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors". Strategies such as collaborate learning, hands-on activities, student projects and the use of technology are components of active learning.

Hands-on activities have been shown to have a significant impact on student learning (Wenglinsky, 2000). When teachers use hands-on activities to illustrate concepts, students perform better on assessments. Concrete versions of abstract ideas help students gain mental pictures that stay with them. Reporting results from a national study Wenglinsky demonstrated that students who were exposed to hands-on learning activities outperformed their peers by more than 70% of a grade level in mathematics.

1.3 Theoretical Framework for the Study

Curriculum refers to the content and purpose of an educational program together with their organisation (Walker 1990). The educational department members at this juvenile justice facility define their purpose as educating these students to make them functional in their environment and avoid recidivism. Four aspects of the curriculum framework used with the students in this study are defined as intended, implemented, perceived, and achieved curriculum. Intended curriculum describes the objective of the course. Students needed to know what they were expected to learn from the instruction. Implemented curriculum displayed how the lessons were presented to the students. Perceived curriculum asked the question "What were the students' views of the curriculum?" and the achieved curriculum asked the question "How much was learned by the student?" Anderson, Anderson, Varanka-Martin, Romagnamo, Bielenberg, Flory, Miera, and Whitworth, 1994, p. 7) summarized the main trends in literature on science and mathematics education in the USA as follows:

1. All students need to develop higher-order thinking skills.
2. Students learning is not a passive activity in which teachers disseminate knowledge to students, but rather an activity in which students must actively construct their own knowledge through a complex process of interaction with their own knowledge structures, engagement with the materials and attention to the dialogue through which they are developing meaning.
3. Learning less information in greater depth is preferable to covering a large number of facts and concepts with little or no understanding (i.e., 'less is more').

Students in this case study were expected to demonstrate what they understood through their evaluation results or their verbal discourse to an academic question asked by the instructor. Active education was utilized for these students through their participation in the classroom hands-on activity, as they used materials other than their textbooks. Time considerations were acknowledged but did not hinder the length of the activity allowing an opportunity for greater depth of understanding for each student.

1.4 Study Sample

Broward, Miami-Dade, and Palm Beach counties in Florida were some of the former homes for these students. Now placed together, regardless of county or gang affiliation, these students were forced to work together and function in the same classroom and living quarters until the judge says otherwise. Upon entry in the facility, the students were required to take an entrance examination that tested their basic skills in vocabulary, spelling, language mechanics, reading comprehension, mathematics computation and mathematics application.

During their incarceration, these students attended school within the facility. Tests, quizzes, and computer assignments were given to these students as would occur in a regular school setting. However, no written homework assignments were given to these students because they were not allowed to keep writing utensils. Before leaving the facility, the students were required to take an exit examination that tested their basic skills in vocabulary, spelling, language mechanics, reading comprehension, mathematics computation and mathematics application once again.

1.5 Purpose of the Study

The purpose of this study was to investigate whether or not there was a significant improvement in student's achievement in and attitude towards mathematics as a result of using the hands-on mathematics approach to learning.

Mathematics requires basic understanding to advance to the next level successfully. Misunderstanding or forgetting a concept will retard a student's mathematical growth (Freislich, 1997). Therefore mathematics prerequisites are required in order to move forward. Without that knowledge, a student may be unable to move on in a course of study or may require equal time in the remedial course of study and in the main course of study. In many cases, new information depends on mastery of the old information. However, Blum (2002) states that "one cannot blame one's intake, because failure to understand appears to occur at all levels. Most current forms of assessment are letting students pass without real understanding, so that it may not be policies about students' progress in a particular institution that need changing, but instead, methods of assessment" (Blum, 2002).

The students in this study attended a residential juvenile justice facility where they received instruction using hands-on learning techniques with the specific purpose of examining the effects of that type of treatment. Both qualitative and quantitative data were collected in this case study that included pre and post tests on attitudes and achievement.

1.6 Research Questions

The present study addresses the following research questions with students enrolled in a juvenile justice facility:

1. What is the intended curriculum for Mathematics in this Juvenile Justice Facility?
2. How was the curriculum implemented in this Juvenile Justice Facility?
3. Are mathematics scales modelled on the Test of Science-Related Attitudes (TOSRA) reliable when used in secondary mathematics classrooms at a Juvenile Justice Facility?
4. What were the student's perceptions of the curriculum, particularly their attitudes towards mathematics in this Juvenile Justice Facility?
5. What was the achieved curriculum for Mathematics in this Juvenile Justice Facility?
6. Were there associations between student achievement & attitudes when teaching with hands-on activities in secondary mathematics classrooms at a Juvenile Justice Facility?

1.7 Overview of the Research Design

Studying social phenomena through the thorough analysis of an individual case is defined as a case study. The case may be a person, a group, an episode, a process, a community, a society, or any other unit of social life (Theodorson & Theodorson, 1969). This case study employed the data from a group of students that were detained in a juvenile justice facility. The research design used in this case study was the quasi-experimental method. Fifty students were pre-tested, exposed to the hands-on instruction treatment, and then post-tested. The quantitative measure employed in this study involved the use of pre and post norm referenced achievement test scores. Informal interviews with the students provided the qualitative data for this study

along with numerous observations of student interaction which were documented in the teacher's journal.

For the purpose of this study, each student responded to the pre and post Test of Mathematics-related Attitudes (TOMRA) (Fraser, 1981) and the Basic Achievement Skills Inventory (BASI); these were the main instruments for collecting quantitative data. The TOMRA assessed student attitudes towards mathematics. The BASI test assessed student achievement in mathematics.

As stated earlier, interviews conducted with the students, as well as classroom observations, provided the qualitative data for this research study. Interviews were conducted in a very relaxed setting to ensure the validity of the information. Formalities were disregarded. Teacher and student were transformed into counsellor and client, as students shared information with the teacher/researcher without fear of embarrassment or ridicule by their classmates. The non-conventional setting provided information to the researcher/interviewer, during recreational time, after group guided intervention (GGI) sessions, walking to the next dormitory, during after-school tutoring, or sometimes even during non-instructional class time during the day. Journal documentation by the researcher provided the verbal discourse during these un-timed sessions with the student. Classroom observations described the learning environment while the verbal interviews described the home environment prior to their confinement in this juvenile justice facility. Classroom observations helped to determine student involvement in the hands-on activity. Student output on the activity response sheet as well as class participation supported the validity of student interest in an activity.

1.8 Limitations of the Study

The limitations of this study included the use of the pre-experimental design because of varying student enrolment due to student court appointments with their judges, appointed release dates that occur randomly throughout the academic year, chronic illnesses and incorrect student-to-security staff ratios due to the absence of the staff that provided control of the facility. As a result, students had to remain in their dorms or be reassigned to a different classroom. These student enrolment instability factors subjected the study to concerns of experimental mortality.

The Florida Department of Education Bureau of Exceptional Education and Student Services (BEESS) and Juvenile Justice Education Enhancement Program (JEEP) imposed a 2006 Corrective Action Plan (CAP) for this residential juvenile justice facility. Within the CAP, there exist several suggestions for corrective actions to improve the effectiveness of student education. Because 85% of the students are court appointed to enter that residential facility, scheduled appointments by the judge requesting an update of student progress could be requested at any time. Regardless of state testing, projects, or even classroom evaluations, the judge's request could interfere with scheduled classroom activities. Students were forced to concentrate on being handcuffed and shackled when leaving the facility to appear before the judge. At this meeting the judge heard reports concerning the student's progress in the program and the student's progress in education as a resident of the juvenile justice facility. Students left the classroom apprehensive about the outcome of their field trip to the judge, and returned to the classroom frustrated or relieved with the judge's decision. This emotional rollercoaster affected the effort and concentration that these students placed on their education. Many times, basic remediation of material was a regular occurrence as the students forgot the material due to their personal stress.

Once students sat through their transition meeting, they are being prepared for discharge into the "real-world" permanently. However, the discharge date was not known by the student until about three to four days prior to his release. The transition appointment confirmed the permanent discharge date of the student from the school. After the transition appointment, students had to be motivated or strongly encouraged to participate in class. Because their release date was only days away, many students felt that there was no purpose in continuing to work inside the juvenile justice facility. Once discharged, the process of education continued for some but ended for many students with the GED test.

The GED refers to the General Education Development credential, the single alternative for adults who never completed their high school education. GED tests are standardized and normed using a national random sample of graduating high school seniors. To pass the tests, a candidate must demonstrate a skill level that meets or exceeds skills demonstrated by 60% of graduating high school seniors. Forty percent of graduating high school seniors would not pass the GED tests, even

though most will still receive a high school diploma (Ormsby, 2007). The GED Test is a 7.5-hour evaluation that measures knowledge, skill and proficiency in science, social studies, mathematics, reading, writing ability, and addresses English mechanics, grammar and comprehension. The GED Test also measures five higher-thinking processes - Critical thinking and deductive abilities, along with practical knowledge and application, are measured to facilitate productivity in the work world. The GED test provided students with a chance to finish school with one large examination. This option was utilised by many students who have passed the age limit for their grade level. Therefore, instruction that began in my classroom could end somewhere else. When the judge provided the release date for the student, they were released regardless of the educational calendar. The regular, random release process was another limitation of this study.

Many students played sports as a form of stress relief. As a result, many injuries occurred to the students. Close to 20% of the students were on crutches, wearing arm or leg braces, or bed-ridden as a result of an injury. This too becomes a limitation of the study as off-campus doctor visits were scheduled during school hours.

The Department of Juvenile Justice imposes a staff to student ratio that must be followed. Whenever the ratio was incorrect, students were re-assigned to specific classes to accommodate the requirement. Once the reassignment was conducted, a student might not be allowed to attend the class and would have to wait until the following week. Because the students at this facility were on a three day rotation schedule, one group attends class once a week until the rotation shifted in their favour. Staff ratios and student rotations presented themselves as minor limitation with workable solutions.

1.9 Organisation of the Thesis

This thesis comprised five chapters. Chapter 1 discussed the rationale and purposes for the present study, gave an outline of the research questions and provided an overview of the organization of the thesis. Chapter 1 also provided a brief background to the study including information about the Basic Achievement Skills Inventory Test, the juvenile justice residential facility in South Florida, the hands-on mathematics activities in a school curriculum, and the limitations to the study.

Chapter 2 reviewed the effectiveness of hands-on mathematics activities and the background of the level-6 juvenile justice facility. Also discussed in this chapter was the historical background of the attitudinal survey known as the Test of Mathematics-Related Attitudes (TOMRA), which was the mathematical version of selected scales from Fraser's (1981) Test of Science-Related Attitudes.

Chapter 3 discussed the methodology used in this study and provided insight into the academic environment that existed for the students. This includes the selection of students, the use of hands-on activities, and the use of responses to informal interviews.

Chapter 4 reported the data analysis and findings for the present study including the comparison of the pre and post BASI and TOMRA scores when compared by instructor. Comparisons were discussed to determine whether associations exist when using hands-on activities; an investigation of the reliability of the TOMRA was examined; and the effectiveness of hands-on activities on student achievement for students detained at a Juvenile Justice Facility.

Chapter 5 concluded the thesis with an overview of the entire thesis. The findings of the study included the comparison of students' academic scores and attitudinal scores, both before and after the implementation of hands-on activities. Furthermore, this chapter discussed the implications, the significance, and the limitations of the present study. Suggestions for success in mathematics retention with at risk students, whether they are being taught in a residential program or a traditional school environment concluded the chapter.

Chapter 2
Literature Review

2.0 Overview of the Chapter

This chapter presents the literature review by addressing four areas. Section 2.1 describes the state juvenile justice system and specifies the characteristics of the system that are unique to the students in this study. Section 2.2 defines at-risk students and provides statistics on the number of at-risk students in the United States. Section 2.3 discusses the effectiveness of hand-on activities, cooperative student centered learning and authentic learning used with at-risk students. Section 2.4 presents a summary of the chapter.

2.1 Department of Juvenile Justice Program

State of Florida Department of Juvenile Justice

The juvenile justice in Florida is administered through a system that includes local law enforcement, the courts, state attorneys, public defenders and privately operated community-based programs that provide prevention and intervention services, treatment programs and aftercare.

The Department of Juvenile Justice was established in 1994. The State and the Department have taken a “Get Tough” approach to juvenile crime. While national reports claim that Florida’s overall juvenile crime rates are down, policy makers, experts in juvenile crime, youth advocates and community leaders agree that Florida’s juvenile justice system lacks the capacity to provide the spectrum of services needed to significantly impact juvenile crime and public safety for the long term.

Under the Juvenile Justice Act of 1994, responsibility for most of the juvenile justice programs was moved from the state’s Department of Health and Rehabilitative Services – a largely social service agency and the primary state agency dealing with services to children and youth – to the newly formed Department of Juvenile Justice. This created a new criminal justice state agency specifically for youth.

In July 2007, Florida's Governor Charlie Crist authorized creation of the Blueprint Commission as a time-limited workgroup charged with developing recommendations to reform Florida's Juvenile Justice System. The Blueprint Commission's 25 members traveled the state, held public hearings and received testimony from a variety of stakeholders such as community leaders, law enforcement and court officers, representatives of public school systems, health and mental health officials, parents, youth, advocates, national experts in juvenile justice and Department staff.

As a result, the members learned the following:

- Communities which bear the burden of providing prevention service for at-risk youth have limited capacity and resources with which to respond.
- Public school systems use Zero Tolerance practices to send youth into the juvenile justice system.
- Regardless of the decline in overall juvenile justice system referrals, the use of secure detention (jail-like setting) is increasing. Florida places youth in secure detention and in residential commitment at rates that exceed national norms.
- There are a growing proportion of girls in the juvenile justice system, which presents a number of health, mental health and programmatic challenges.
- There is a disproportionate number of minorities in the system. The disproportion is noted to increase as the inquiry goes deeper into the system.
- At all levels, across gender and race, the health and mental health needs of youth in the juvenile justice system are extraordinary, with two-thirds of youth in some cases, having mental-health or substance-abuse issues.
- The Department of Juvenile Justice direct-care staff is poorly equipped, compensation is low, and annual turnover ranges from 35% to 66%, depending on the employee category.

Working with advisors, the Blueprint Commission identified 53 recommendations for change, organized under seven guiding principles and 12 key goals that were designed to be implemented over multiple years. The recommendations can be summarized as follows:

- The State of Florida needs to invest in a continuum of services that can provide the right services at the right time in the least-restrictive environment,

while continuing to provide serious sanctions for youth involved in serious and violent crime, where appropriate.

Florida should invest in community-based programs that help keep kids out of trouble.

Florida should develop alternative programs and interventions at the community level to prevent youth who do not pose a public safety or flight risk from placement in secure detention.

For those youth who require commitment to residential facilities, Florida should provide facilities that are small, that provide good educational and skill-building programs, and that best prepare youth for return to their communities.

Florida must provide adequate resources to meet the mental and physical health needs of youth in the juvenile justice system.

Florida must invest in the human resources that provide direct care services to youth in the system and develop a more professional and stable workforce.

Florida should implement only those programs and strategies that are evidence-based, that have been demonstrated to be effective in protecting public safety while at the same time providing an optimum future for our youth.

Florida must provide gender-specific programming that effectively addresses the needs of girls in the juvenile justice system. Additionally it must address the disproportionate presence of minorities in the system.

In keeping with the recommendations from the Blueprint Commission, the students in this case study resided in a gender-specific program as every student detained at the facility was male. However unlike the recommendation, the disproportionate presence of minorities at this facility remained intact as approximately 95% of the student population was a member of a minority group. Overwhelmingly, the greatest representation of minorities at the school was by African-Americans followed closely by Hispanic males.

The findings and recommendations of the Blueprint Commission were intended to guide and support the Department and the State. The recommendations from the Blueprint Commission are used to provide staffing and budgeting recommendations

at individual centers in South Florida. During the next ten years, the State of Florida emphasized and invested in incarceration and deep-end residential placements at the expense of less restrictive responses and prevention and intervention programs. In 2000, the Florida Legislature determined that all placements would be residential placements which eliminated the judge's options to place youth in minimum-risk, non-residential programs. Data from the Blueprint Commission reported that in 2003, the State of Florida was committing more that 285 juveniles per 100,000 population which was in excess of the national average of 218 per 100,000. Presently there are more than 5,500 youth in residential placements which is more that 285 per 100,000 population. According to the 2006 National Report, the rate exceeded national norms.

Florida statute required that a youth taken into custody may not be held in detention for more than 24 hours unless by court order. Approximately ninety-five percent of the students in this study are required to attend the facility by a court order. This secure detention is a jail-like facility where these students receive basic educational, medical, and counseling services and are allowed visitation, correspondence and telephone calls.

Miami-Dade County Department of Juvenile Justice

Public school systems are under stress, especially in Miami Dade County as the immigrant population supplements the rapid growth. The Zero Tolerance practice aids educators in sending youth into the juvenile justice system for rehabilitation rather than applying alternative methods of discipline. An Interstate 10 killing in 1993 triggered a major shift toward harsh punishment for juvenile offenders; other incidents have triggered calls for re-evaluation of the "get-tough" policy. A decade later, on June 9th 2003, Omar Paisley, 17, collapsed and died at the Miami-Dade Juvenile Detention Center of a ruptured appendix. Paisley had complained for three days of stomach pain and suffered from vomiting and diarrhea but had been denied access to physicians (Miami, Herald, 2003). However, the need to rehabilitate the youth in Miami- Dade County is both therapeutic and financial. The Blueprint Commission reported that the State of Florida spends $2,128 per child for prevention services, while the amount spent per child committed to residential and correctional facilities is $42,606. A balanced continuum is the suggested solution to manage the

influx of children being placed in the juvenile justice system. The balanced continuum involves prevention/early intervention, diversion, probation, day treatment/non-residential, residential, and aftercare/conditional release.

Disproportionate Minority Contact

The Florida Department of Juvenile Justice created a Disproportionate Minority Contact (DMC) task force with representation from education, law enforcement, state attorney, public defender, judiciary, community of faith, providers, advocacy organizations, members from communities most affected, and other stakeholders, to reduce DMC, statewide. The DMC task force charged local juvenile justice boards and councils with the responsibility to develop a DMC reduction plan for their area. The Department of Juvenile Justice shall require every entity with which it works, throughout its continuum of services, to implement the strategies, policies, and practices to reduce DMC. The 2007 Referrals and Incarcerations by Race Report provided the following data:

> Of the youths referred to DJJ, 7% were White, 47% were Black, and 38% were Hispanic. Of those youth incarcerated, 4% were White, 52% were Black, and 36% were Hispanic. This statistical information provided a window into the environment that exists at the South Florida detention centers.

Detention Services

Employing more than 2,000 staff with a budget of $137.5 million is the definition of responsibilities for the Detention Services Division. More that 55,000 youth are served at the state's 26 detention centers according to the Blueprint Commission's findings. Those youth who are awaiting placement in residential treatment and those who are awaiting disposition and sentencing comprise the detention center population. General revenue funds are the main source of funding for detention centers. Federal funds support meal expenses and local school districts are responsible for a portion of the educational costs. Counties are required to pay a portion of the cost of detention services, if they are not fiscally constrained. According to the Blueprint Commission, in 2008 Dade County will be required to pay $10million. The students in this study are from several counties but are detained in a Dade Count facility. Dade County sustains the highest cost as Hillsborough and

Orange counties will be required to pay $8 million; and Broward County, $7 million; while Monroe County will pay $368,000; Hernando County, $279,000; and Walton County, $218,000.

Detention centers are not equipped to provide long-term, intensive mental health or medical services. However, detention centers provide medical care and screenings, counseling and crisis intervention, most of which are provided by independent contractors, not by state staff. The mental stability of the students at this facility was considered as these students were removed regularly during class time for counseling sessions, medical appointments, and to receive medication. For example, traumatic stress counseling was provided for those students that witnessed the violent deaths of their loved ones.

2.2 Definition of At-Risk Students

At-risk students exist in every school from the inner city school to the Ivy League school. What denotes the difference with these students is the type of instruction that they receive. Several years of research exists about these students. However, some educators have not altered their classrooms and teaching strategies to reduce the difficulties that these students encounter.

Several factors contribute to a student being labeled “at-risk” (Stronge, Popp, & Grant, 2007)**.** At-risk students are defined as students who lack support to succeed in different areas of their lives namely societal, familial and/or school. Hunger and nutrition, living in poverty, and student mobility are home and societal factors to be considered when identifying at-risk students. School factors include the availability of a qualified teacher, rigorous curriculum, schools climate, and school safety. Many qualified teachers prefer a safe less stressful environment. The teaching profession provides its own daily challenges. Once coupled with an unsafe environment and uncooperative students, the recruitment possibilities decrease tremendously.

One of the factors leading to a student being labeled at-risk is poverty. In 2005, the Census Bureau reported that 17.6% of children (under 18 years of age) were living below the poverty level (Denvas-Walt, 2006); 16.2% of school-age children were reported as living in the poverty line (United States Census Bureau, 2004). Children from minority families are more likely to live in poverty than those from Caucasian

families which explains the population of students that are a part of the study. 95% are minorities. In 2005, approximately 10% of Caucasians lived below the poverty level compared to 24.9% of African-Americans and 21.8% of individuals of Hispanic origin (Denvas-Walt, 2006).

The findings of one case study conducted by Scott Day of at-risk 8th grade students were considered to determine what effective strategies could be used with these at-risk students who were detained at the Juvenile Justice Facility. Responses to the research revealed that students felt more motivated to learn, received better grades and accepted more responsibility for their work in the lab environment. The laboratory environment facilitated cooperative group work, authentic task and assessments, and appropriate use of technology by the students. In short, these students discovered the application of the discipline versus the sole computation of the information in the discipline. With the absence of the technology laboratory in the classroom, a decision was made to use the laboratory techniques employed in the study instead of relocating the classroom to a laboratory specifically for cooperative group and authentic tasks and assessments. Multiple techniques were utilized when working on the student projects specifically using interesting topics such as cars and spending money. Also, the use of edible activities was another successful technique as students measured, calculated and snacked during the cylinder activity. Effective teachers of at-risk students use a variety of instructional techniques. A survey of low-income students revealed that these students value teachers who are able to teach in a multitude of ways (Corbett & Wilson, 2004). Educators support those student responses. When educators were surveyed regarding the characteristics of effective teachers of at-risk students, they agreed that effective teachers meet the special needs of their students by implementing a wide array of instructional techniques (Ilmer, Snyder, Erbaugh, & Kurtz, 1997). Broader research has shown that at-risk students are poorly served in many schools nationwide (Letgers, McDill, & McPartland, 1993). The class comprised solely at-risk students. Poverty, race, language, and other factors determined the labeling of these at-risk students.

2.3 Teaching and Learning Approaches

Cooperative, Student-Centered Learning

Cooperative, student-centered learning techniques engage and empower students, and they provide a clear and convincing example of changes within the control of individual teachers. Johnson and Johnson (1989) offered the reminder that "Students often feel helpless and discouraged. Giving them cooperative learning partners provides hope and opportunity. Cooperative learning groups empower their members to act by making them feel strong, capable, and committed" (p.1). When students become responsible for their own learning, they become more successful at acquiring knowledge and solving problems creatively. Cooperative learning methods are consistently effective in increasing student achievement (Slavin & Madden, 1989). At-risk students are typically in need of caring and committed peer relationships, social support, and positive self-images, as well as motivation for higher achievement; cooperative learning experiences supply these specific benefits (Johnson & Johnson, 1989).

In this study, cooperative learning techniques were used as the student compared living arrangements in the apartment shoppers guide while discussing and comparing basic living options such as car purchases, laundry facilities, utility costs and basic investments. The constructivist approach was used to instruct these students. Constructivist teaching and learning models emphasize the context in which an idea is taught as well as students' prior experiences and attitudes; they enable students to take an active role in their learning. This model also suggests that activities and contexts should be meaningful to students so they will make connections between classroom learning and the world outside the schools (Means, 1997; Means & Knapp, 1991).

Hands-on Mathematics Activities with At-Risk Students

The widely used term "at-risk" student was defined by McCann and Austin (1988) using three characteristics. First, they are students who are at risk of not achieving the goals of education, of not meeting local and state standards of high school graduation, and of not acquiring the knowledge skills, and disposition to become productive members of society (receiving less than a 2.00 grade point average). Second, they are children who exhibit behaviours that interfere with themselves and

others attaining an education, requiring disciplinary action (at least 3 incidents). Third, they are those whose family background characteristics may place them at risk (low income to below poverty level, non-English native speakers and so forth). (p 1-2) Basche (1985) developed a list of common characteristics that further define at-risk students. The at-risk student tends to have a history of school absenteeism, poor grades, low math and reading scores, low self-concept, a history of behavioural problems, inability to identify with other people, full time employment while in school, low socioeconomic background, more males than females, and feel alienated and isolated. (p 1) Additionally, the at risk student's family characteristics include families with several siblings, father absent from the home, father unemployed, father did not complete high school, mother absent from the home in early adolescence and little reading material in the home.

A study explaining the reasons why at-risk students remained in school was performed by Power (1984). The study found that the at-risk student's individual achievement level and academic performance was directly related to the student's decision to remain in schools. The evidence was consistent among at-risk students with regard to the hands-on learning theory. The students indicated that they learned better through hands-on learning methods than through book work or lecture methods (Dewey, 1900, 1916, 1938; Herschbach, 1996). Another study performed by Taylor-Dunlop and Norton (1997) included eleven at-risk female students aged 15 to 17 in New York. The three Latino, two Caucasian, and six African-American at-risk students participated in focus groups, individual interviews, and small group meetings. The results of Taylor-Dunlop and Norton's study supported the concept of having supportive links between at-risk students and their teachers, counsellors, and friends. The students also indicated that they came to school because they enjoyed math and hands-on courses.

A qualitative research study was conducted on eight at-risk students in a technology education program (Cardon, 2000)**.** The study was limited to the male at-risk students. Even though the findings were limited to the population of the study, generalizations were made in regards to the qualitative study. For the purpose of this study, evidence from previous studies suggested that the integration of subjects in a hands-on learning environment could benefit at-risk students.

A qualitative two year study of two groups of fifth graders utilized a hands-on activity that revolves itself around an adult task. A Class Banking System was created to revive a dull class environment with the hopes of improving student attitudes concerning mathematics (Spinner, 2002). This hands-on activity enables teachers to utilize the constructivist approach to instruction. The TOMRA was one of the instruments used as a pre and post test to assess the effectiveness of the CBS. For the purpose of his study, CBS students were compared to non-CBS students with results suggesting that more favourable changes were experienced by the CBS students in regards to their attitudes towards mathematics (Spinner, 2002).

There are many reason students have achievement difficulties. The term at-risk was intended to identify and support these students in their educational pursuits. Many of the reasons for this at-risk description include cognitive differences, family stress, racial and cultural bias, students whose first language is not English, disability, and tracking (Schwartz, 1987). The solution may lie in various parts of the educational system but one component of creating success for these at-risk students is found when these students are placed in cooperative student groupings. This hands-on, inquiry-oriented science curriculum, with students divided into small mixed ability cooperative groupings, has been shown to be more effective than traditional teaching methods (Schwartz, 1987). Students learn to solve problems independently, and help each other develop skills according to Schwartz.

Hands-on instruction is good for the kinaesthetic learner while having lots of pictures and charts are good for the visual learner. Instruction that includes hands-on activities and cooperative groups has been associated with increased academic performance (Taylor, Pearson, Clark & Walpole 2000). While many studies focus on specific techniques and their impact on student achievement, the common factor among the studies is the focus on using a variety of instructional strategies.

Authentic Learning

Students that engage in higher-order thinking possess the key component of high-quality instruction. At-risk students can be included in problem-solving activities along side their classmates without complete mastery of the basic skills. The students in this study gained a further understanding of the basic concepts within the

assignment as was evidenced by the questions that were asked throughout the duration of their tasks. This supports the statement that the “pull out” technique must not translate into a “left out” procedure that does not provide at-risk students with an opportunity to participate in challenging work. At-risk students are provided with an opportunity for success when they participate in challenging activities. Rather than treating the absence of essential skills as a roadblock for at-risk students, instructors can emphasize opportunities for learning and practicing basic skills through the use of authentic tasks (Means, Chelever, & Knapp, 1991). In this study, the check writing/budgeting project and the volume of a cylinder project both provided examples of the approach. Students were required to use basic mathematics skills and apply them within many areas of the budgeting project. Furthermore, basic skills, along with the use of formulas, were involved as the students were required to create two cylinders and find the volume manually and mathematically.

Motivation to learn is an important component for at-risk students because they can be easily discouraged by constant lower-level drills and practice sessions that seem to focus on their weaknesses and repeated failures. Means and Knapp (1991) showed that by not challenging at-risk students or not encouraging them to use complex thinking skills, teachers underestimated the students’ capabilities and, as a result, discouraged their exploration of interests and meaningful work they could accomplish. DiCintio and Gee (1999) echoed earlier findings that “at-risk adolescents are unmotivated to learn because the tasks they are asked to complete are not motivating them” (p. 231). This practice disheartens students and makes it unlikely that they will transfer learned skills to real-world tasks (Resnick, 1987). The check writing/budgeting project in this study provided an opportunity for the students to transfer a learned skill to several real world tasks. Students were allowed to set their own pace within the projects’ timeline. As a result, many students did not give up as easily. The flexibility of the assignment to allow the students to make choices on their project resulted in the students learning with less stress. Some researchers believe that an optimal situation exist when classroom activities are structured around long-term projects with an authentic purpose, the value of the project task is apparent, students are challenged by more complex content, and the basic skills are dealt with in context, providing a motivation for mastering skills (Means & Olson 1995). Classroom performance and real-world success must

include concepts of higher-order thinking, authentic assessment, and purposeful activity. Using hands-on mathematics activities in the classroom encourages greater student input which may lead to improved achievement and attitude scores in at-risk mathematics classrooms.

Several years of research has been conducted on students at risk of failure (Day, 2002). Some educators still have not changed their classrooms and teaching practices to accommodate these students. Students responding to a survey reported feeling more motivated to learn when the talk–and-chalk method was not the only source of instruction. This motivation leads to receiving better grades and accepting responsibility for their work.

Broader research has shown that at-risk students are poorly served in many schools nationwide (Letgers, McDill, & McPartland, 1993). Students enter the school with additional stresses on their minds which places education at the bottom of their list of priorities. Different strategies must be used to promote an interest in school for at-risk students. The 1990 reform initiatives required that educators revise the traditional model of instruction for all students because all students cannot be taught the same information in the same way. An increasing number of educators and researchers are calling for higher standards and more challenging activities, especially for students who are at risk of failure due to poverty, race, language, or other factors (Ogle, 1997).

Educational improvements that are research-based can reduce the risk of failure for at-risk students. A hands-on curriculum which incorporates cooperative group work, authentic tasks and assessments, and technology can provide the variety needed to maintain student interest in the classroom. To show how incorporating hands-on activities into the curriculum can assist students, this study examined a group of male at-risk students at a residential juvenile justice facility who were instructed using the hands-on curriculum in their mathematics classroom. The students' attitude and achievement in the classroom provided interesting insight into their feelings about the classroom and their understanding of the subject.

All students must learn to think mathematically, and they must think mathematically to learn (Kilpatrick, Swafford, and Findell, 2001). No Child Left Behind Act (2001) directed that research about effective practices be a guide in changing the way mathematics is taught so that high standards are met leading to an improvement in achievement. “Active Teaching” model has been enhanced annually to support successful teaching and learning strategies for all students (Rand Mathematics Study Panel, 2003). This model is simply teacher-directed instruction that proceeds in small steps. Research indicated that this approach is associated with higher levels of student achievement. Students are guided through the following learning process: Introduction to skills; Guided practice; Independent practice; Assessment; Critical thinking activities and Homework with parent activities.

A finding in The Nations’ Report Card: Mathematics 2000, National Assessment of Educational Progress (NAEP) showed that the average scores of fourth and eighth graders generally increased as the amount of instructional time for mathematics increased. Grouws and Cebulla (2000) state that there is a positive relationship between total time allocated to mathematics and general mathematics achievement. Therefore, students engaged in active learning, at-risk or otherwise, would benefit from engaging in hands-on instruction where the time spent on the project is increased and also enjoyed by the student. Open-ended problems also provide room for student discovery within hands-on projects. Flexibility develops through the expansion of knowledge required for solving open-ended problems. Open-ended problems require the student to use productive thinking to create a way to understand and solve the problem since an immediate solution method is not known. Within the volume of a cylinder project, students were asked to consider why some companies use boxes for their products instead of a cylinder. In the check writing/budgeting project, students were asked to consider the actual cost of an item that was financed with various interest rates. These open-ended inquiries led to a variety of responses both verbal and written.

Research findings indicated that certain teaching strategies and methods are worth careful consideration as teachers strive to improve their mathematics teaching practices. Stigler and Heibert (2004) advocate that when the improvement of teaching methods becomes the focus, student performance will show more positive

results. Teacher and student interaction are vital to student improvement. Many students learn mathematical concepts best through the manipulation of concrete materials because it helps them to build a mental representation of the concept. Manipulatives provide concrete introductions to abstract ideas. Further research findings state that every student should have an opportunity to have adequate “hands on” experiences with appropriate manipulatives before engaging in pencil-and-paper activities. One recommendation is that every classroom have an assortment of manipulatives for student accessibility at all times with ample time for free exploration. Long-term use of concrete materials is positively related to increases in student mathematics achievement and improved attitudes towards mathematics. Research by Grouws and Cebulla (2000) suggests that teachers use manipulative materials regularly in order to give students hands-on experience that helps them construct useful meanings for the mathematical ideas they are learning. Using the same manipulatives to teach several ideas reduces the amount of time spent introducing an object which results in a more purposeful usage of the manipulative and greater time to establish connections between the concepts being taught. However, this of course does not prevent a teacher from introducing other manipulatives at any time but allows for student familiarity and further exploration. Coincidently, studies indicate that instruction which emphasizes active student engagement in hands-on opportunities improves attitudes toward mathematics and indicates a positive effect on mathematics achievement.

2.4 Summary of Chapter

This section reviewed the State of Florida Juvenile Justice System, the definition of at-risk student, and the alternative instructional strategies used with various students to investigate the effectiveness of using hands-on activities with males students detained in a juvenile justice facility. The review considered various teaching techniques in order to draw parallels to the findings from those adapted techniques in the reviewed literature and those techniques used in the case study.

Chapter 3
METHODOLOGY

3.0 Overview of the Chapter

This chapter outlines the research problem and questions, the context of the case study, the research design, the theoretical framework, the background and selection of the sample, the teaching intervention, and the quantitative and qualitative data collection procedures and analysis. The chapter is divided into ten sections. Section 3.1 contains the description of the research problem and the outline of the research questions of the study and section 3.2 describes the context of the case study. Section 3.3 describes the learning environment and section 3.4 describes the study group. The research design and theoretical framework of the study are presented in Sections 3.5 and 3.6, respectively. The background and selection of the sample and the teaching intervention are discussed and revealed in sections 3.7 and 3.8. In Sections 3.9 and 3.10 respectively, the quantitative and qualitative data collection procedures and analysis are described. Lastly, section 3.11 completes the chapter with a summary.

3.1 Research Problem and Research Questions

Concerns exist over the academic effectiveness of providing hands-on instruction for mathematics students. School administrators that actively pursue the most qualified teachers hope for high expectations of academic achievement for the students in their school. However, there is national concern specifically about the mathematical proficiency of the students who exit these schools and graduate in the next few decades (TIMSS, 2007). One method of instruction that is used to stimulate interest and promote success in school is called hands-on instruction. The at-risk students in this study have numerous distractions that contribute to their lack of success in the school system. This study investigates whether integrating hands-on mathematics activities into the schools curriculum promotes significant changes in students' mathematics achievement scores and students' attitude towards mathematics. The study took place in a juvenile justice facility in South Florida.

Both qualitative and quantitative data were used in this pre-post comparison case study. Academic gains in achievement were measured by the Basic Achievement

Skills Inventory (BASI) and attitudes towards mathematics were measured by the Test of Mathematics Related Attitudes (TOMRA).

The present study addresses the following research questions:

1. What is the intended curriculum for Mathematics in this Juvenile Justice Facility?
2. How was the curriculum implemented in this Juvenile Justice Facility?
3. Are mathematics scales modelled on the Test of Science-Related Attitudes (TOSRA) reliable when used in secondary mathematics classrooms at a Juvenile Justice Facility?
4. What were the student's perceptions of the curriculum, particularly their attitudes towards mathematics in this Juvenile Justice Facility?
5. What was the achieved curriculum for Mathematics in this Juvenile Justice Facility?
6. Were there associations between student achievement & attitudes when teaching with hands-on activities in secondary mathematics classrooms at a Juvenile Justice Facility?

3.2 Context of the Study

Miami-Dade County, previously known as Dade County, is a county located in the southeastern part of the state of Florida. Dade County was created in 1836 and named after Major Francis L. Dade who was a soldier killed in 1835 in the Second Seminole War. It is the most populated county in the state, according to the 2000 US Census report, with a population of 2,253,362. Coincidently, the 2005 US Census Report stated that Miami-Dade County's population is estimated at 2,376,014 which makes it the eighth most populous county in the nation. (US Census Bureau, 2005).

The Miami-Dade County Public School system is the fourth largest school district in the United States with a nine member, publicly elected, school board which is responsible for overseeing the administration of the schools. The district with an ethnic make-up of 10% White, 29% Black, 59% Hispanic, and 2% other nationalities is divided into six regions (MDCPS, 2004).

This study took place in an alternative boarding school that provides educational, vocational and therapeutic services to moderate-risk adolescent males. The school

was founded in 1995 on a former missile base that once housed volunteers and materials for the rehabilitation of the homes destroyed by Hurricane Andrew in 1992. The founder of the school contracted with the Department of Juvenile Justice to establish a school to rehabilitate the lives of 36 troubled young males. In 1995, the school was established as a pilot boarding school for 13 to 18 year old juvenile delinquents. In 1998, the Juvenile Justice Accountability Board rated the school as the best commitment program of its kind in the state (Rubin, 2000). Every student admitted to the school was registered with the county public school system and each student was assigned an academic schedule based on their entrance test results.

The student's functioning level, without regard to age, and test results determined the academic schedule for placement of each student. Because many levels of student abilities existed at the juvenile justice facility, multi-level grouping was a necessary component to educate the students. Multi-level grouping dictated that Mathematics 9-12, Liberal Arts Mathematics, Algebra I and II, and Geometry, all be taught in the same classroom. This differentiated type of instruction had to be reflected in the instructor's lesson plans citing the individual goal and textbook used for each subject within the classroom. Unlike a traditional school, the students in this facility were not taught one subject per classroom or allowed to have pencils, paper or any school supplies. Students in this study attended school on the bottom floor of one of the three dormitories where all materials were provided by and secured by the instructor daily.

This Juvenile Justice Facility where this study took place was designated a level 6. The Department of Juvenile Justice uses four residential restrictiveness levels to place a youth: low, moderate, high and maximum risk numbered as levels 4, 6, 8, and 10. The purpose of a juvenile justice commitment program is to protect the public from acts of delinquency and to treat offenders so as to reduce recidivism. Judges, taking into consideration the recommendations from the Department of Juvenile Justice staff and the State Attorneys, determine the degree of security required and commit each youth to the Department of Juvenile Justice at a specific restrictiveness level. A restrictiveness level is a classification based on the risk a youth presents of harming the public. Using the specified level, the department is responsible for assigning each youth to a program that will meet his or her treatment needs. The

students in this case study reside at one of these housing facilities. Each student's behavioural levels were conveniently evident through the various coloured t-shirts that they were required to wear.

Each student enters the program as a Concern and was required to wear a red shirt. The behavioural hierarchy was the following: Concern (Red), Neutral (Brown), Positive (Blue), Observation (Yellow), Pledge (Purple), and Falcon (Green).

> Concern – Every student was placed at this level when he arrived. He was carefully monitored every minute of the day and had no privileges. He had to memorize the Student Manual as the first step toward moving up in receiving privileges.
>
> Neutral – This was the first step up the continuum and allowed for some loosening of the tight monitoring. The student had not demonstrated much positive behaviour at this level but he was less negative in his attitude.
>
> Positive – This next step up the continuum occurred because the student was making some effort to be positive and to fit into the program structure. A positive student earned some measure of trust and assumed some responsibilities within the program. At this level the student also earned more privileges and was less restricted.
>
> Observation – The student at this level demonstrated that he could assume responsibility well and understood that he must avoid anti social behaviour. He was now on observation for election to the student government, the Falcon Club.
>
> Pledge – The student at this level had one task to accomplish to become a Falcon. He had to complete a log book. This entailed either confronting other students for negative actions or praising them for positive ones.
>
> Falcon's Club – Once the log was completed and with full confirmation from the security staff and Falcons, the student was welcomed into the student

government, the Falcon's Club. These students assisted the staff in their responsibilities. To earn the Falcon's status, the student had to demonstrate positive behaviour and learn to accept and to give confrontation. As Falcons they had to appreciate the fact that others helped them in their climb up the status ladder and now it was their turn to help others do the same. In return for this achievement students earned many privileges such as home visits, fishing trips and sports events.

The students slept upstairs in dorm-like accommodations and attended classes downstairs in an area that was regularly converted into a recreation room in the early afternoon. Everyday students were lined-up to go to the cafeteria for three well-balanced meals where a head count was taken for departure to the cafeteria, for return to the classroom, and at arrival to the classroom. The task was completed by having each student "sound off" their position number in the line. Phone privileges were only allowed to deserving students on weekends and in emergency situations.

3.3 The Environment in which Students Live and Study

An open setting existed for these students as class was conducted in a large room that was used for different activities every evening. The daily transformation that was performed to prepare the room for class meant that no student desks were in this room. Chairs and tables were removed from the cafeteria, clean or dirty, and provided for classroom use. The morning classroom area was the evening recreation area. Huge, sealed glass panes surrounded the classroom, which facilitated the warmth of the sun entering the room and the view of the campus activity at the school. On several occasions, many students from both campuses waited for clinic appointments, court appointments, or school schedules on the perimeter of the classroom. These students were an unwelcomed distraction for the students in this study.

As an instructor at this juvenile justice facility, I was required to maintain order, purchase, distribute and inventory all supplies that were not provided by the county in addition to delivering the lesson to the students. Supplies at this juvenile justice facility also had to be distributed, counted and locked in a secure area to avoid unauthorized use of these items by the students.

Arrival to the classroom followed a 5am wake-up call, hygiene protocol, and 20 minute breakfast for the students. Students were required to walk from the cafeteria in a line, according to their earned behavioural status, and quietly enter the classroom. Upon entering the classroom, they remained standing in a line, raised their right arm when instructed, and "counted off" their number in line. Student counts were a regular, mandatory routine for the students in this juvenile justice facility. Immediately following the counts students rushed to get their favourite seat in order to begin their group guided intervention (GGI) session. Group guided intervention was conducted when all the students in that building sat in a circle as an executive student leads the discussion for the day. For next 30 minutes, each student in the circle was expected to share his personal accomplishments, fears, goals, or experiences with the students in the group when called upon. Each personal student testimony varied in length and at times required student and staff responses to several issues. GGI sessions were conducted every morning and generally lasted for about 30 minutes. These sessions usually encouraged the behavioural atmosphere for the day. Immediately following the session, four students and a support staff walked to the cafeteria to get the tables that would be used as student desks in the classroom. While the tables were waiting to arrive, the students were divided into their groups and sent to the second classroom with one support staff per group of students. Usually 15 – 18 students were in each group.

A scheduled bathroom and water break was also provided to these students before class began. These students slept above their classrooms in a dormitory that holds about sixty students with no television or telephone privileges. On special occasions, televisions were permitted upstairs in the sleeping quarters but telephones were strictly prohibited.

3.4 The Study Group

The students in this case study were divided into six groups of 15 – 18 students that had two classes a day. This schedule required a four day rotation period before a student could return to a class for instruction. As an example, a student that attended the Mathematics class and American History class on Monday did not return to that class until Thursday. This was created as a means of facilitating less campus

movement from one dormitory to another dormitory. As a result, the four day rotation was created with each class being in session for ninety minutes.

Students in this study were aged between the ages of 13 and 18 years. Many of them revealed that they had not been in school for the last two to three years. Consequently, basic mathematics facts such as multiplication were a distant memory. Being able to understand references to weights namely grams, ounces, and pounds was directly related to the street drugs that they sold to sustain their lifestyles.

In contrast, a few students were able to grasp higher order thinking equations that involved imaginary numbers. Problems that used the quadratic formula and Pythagorean Theorem were solved with greater understanding by a select few. These students were preparing to take the Scholastic Aptitude Test (SAT), General Education Development Test (GED), or American College Test (ACT) through supplementary instruction that was received from after school tutoring classes and online independent study programs. Questions asked by these students surprised the instructor but were of no interest to the majority of the class. Greater development of conceptual understanding was unavailable to these students as class time was required to accommodate the wide range of abilities that existed within the classroom of students.

The campus accommodated three two-story dormitories with two classrooms in each dormitory. Administrative business was conducted in a two story building that adorned the campus and provided health services for students, staff training rooms for employees, cafeteria, reception area and an in-take room. An electronic gate provided security for its residents but there was no barbed wire to secure the perimeter, as expected. However, the perimeter had a lake as a partial enclosure where several alligators had been captured. These factors, along with student flight risk concerns, justified minimal campus movement, hence the two subjects, four-day rotation schedule.

3.5 The Research Design

Case studies provide an opportunity for the researcher to present an idea that will be studied in detail, using whatever methods seem appropriate. Stake (1994) defines

three main types of case studies. The first is the intrinsic case study where the researcher wants a better understanding of a case; second is the instrumental case study where the case is examined to give insight to an issue; and the third is the collective case which is an extension of the instrumental case study to involve many cases. This study is both intrinsic and instrumental in nature. From the research, the intention is to gather evidence to support a more effective method of instruction for these at-risk students. This information provides insight about at-risk students in general with emphasis specifically on these students.

Case studies have become one of the most common ways to do qualitative inquiry (Stake, 2000). The use of everyday language invites a greater audience to participate in and discuss the contents of the study. Nisbet and Watt (1984) noted that the results of case studies are more easily understood by a wider audience (including non-academics) as they are frequently written in everyday, non-professional language. Case studies are noted as being strong on reality and on providing insights into other similar situations and cases.

Cohen, Manion and Morrison (2000) maintained that case studies provide a unique example of real people in real situations, enabling readers to understand the events more clearly than simply presenting them with abstract theories or principles. In addition, case studies can penetrate situations in ways that are not always susceptible to numerical analysis. Further case studies can establish cause and effect; indeed one of their strengths is that they observe effects in real contexts, recognizing that context is a powerful determinant of both causes and effects (Cohen et al., 2000).

Within the case study, quantitative measures were employed that involved the use of pre and post norm referenced achievement tests to measure the student's mathematics, reading and language arts levels (Anderson, 1998). All the students in this case study were given the achievement test regardless of age.

Qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. The qualitative research collected in this study was obtained by several methods such as student surveys, observations and verbal interviews that were documented in a chronological journal. Because qualitative

researchers study events in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them, I chose to have the students in this study provide information to me in various locations. Some students spoke to me during unassigned classroom time while others talked during the after school tutoring sessions. Post-activity surveys also provided qualitative information about student attitudes concerning the completion of an activity.

Qualitative research involves the studied use and collection of a variety of empirical materials that can include a case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts. These materials can describe routine and problematic moments and meanings in individuals' lives (Denzin & Lincoln, 1994). The informal interviews with the students in this study provided additional qualitative data along with numerous observations of student interactions on the campus.

While making use of the various research methods, triangulation was used. Triangulation is when multiple research methods are employed and the same pattern appears in more than two types of data. But, triangulation also can result in inconsistent and contradictory evidence that must be rendered sensible by the researcher or evaluator. Nevertheless, all researchers strive for some type of generalization in their study. While triangulation might create inconsistent data that are too difficult to generalize, the use of multiple methods and finding the same theme from more than two sources of data, make the research better able to withstand unfavourable critique by colleagues (Mathison, 1988).

Personal experiences outside of the classroom determine the receptive nature of the student to participate in any classroom activity whether a lecture or a hands-on activity. The nature of the program ensured regular classroom attendance because these students could not legally leave the facility without an escort or a judge's approval. However, the students in this case study found it difficult to focus in the classroom due in part to the circumstances of their enrolment in the school. Legal appointments and untimely off-campus medical appointments contributed to the quality of educational instruction received by these students.

In qualitative research, the researcher is the principal data collection instrument. The qualitative researcher must acknowledge conceptual and theoretical understanding of the participants' social reality (Anderson, 1998). Field work within the contexts of this study involved retrieving information regarding the prior home environment from the students. The current strategies employed by these students to adjust to their new living environment were also acknowledged through visual observations and verbal confirmations from the student.

Multi-level grouping affected the quality of educational instruction in the classroom. Because of the diverse ranges of academic abilities in the classroom, teacher interaction with students was severely truncated to accommodate the many needs of the academic groups that existed in the classroom.

The intent of qualitative research is to uncover the implicit meaning in a particular situation from one or more perspectives. The data may include dynamic interaction such as one observes or analyses through discourse, semiotics, narrative and content analysis (Anderson, 1998).

Correlation is a statistical procedure used to determine how two or more variables are related or how much they are related. The approach uses quantitative data and involves no intervention or manipulation other than that required for administering the instruments needed to collect the necessary data. Correlation research attempts to describe the relationships among naturally occurring variables or phenomena without attempting to change them (Shulman, 1997). This study sought to determine if there was a correlation between the outcomes in mathematics (attitude and achievement) based on hands-on instruction given to at-risk students at a juvenile justice facility. The correlation method enabled the researcher to predict what would occur with at-risk students who engage in similar instructional strategies within the same learning environment.

3.6 Theoretical Framework and Related Activities

Students were required to take an achievement test called the Basic Achievement Skills Inventory (BASI). The pre-BASI was given to each student within the first three days of their arrival to the facility. All students were required to take the BASI

test to provide a baseline in determining proper placement and scheduling into the core classes, namely Mathematics, Language Arts and Reading. Each student's pre-BASI score was recorded on a data table.

Gokhale defined hands-on learning theory as "The basic premise of this theory is that students learn as a result of doing or experiencing things in the world, and learning occurs when mental activity is suffused with physical activity" (p.38). Dewey (1900) believed that, through hands-on activities, students could combine intellectual stimulation with activities that expanded learning. Gokhale's hands-on learning theory was used in this study.

A four curriculum framework used by Treagust (1987) to identify exemplary teaching practices was also used in this study. The four aspects of the curriculum were used as a template for this study, namely, the intended, implemented, perceived and achieved curriculum. The intended curriculum briefly described the focus of the instruction as well as the nature of the work; the implemented instruction described what the students did in the classroom using both the qualitative and quantitative data on the hands-on instruction; the perceived curriculum described what students seem to understand for both the qualitative and quantitative data; and the achieved curriculum reported the student progress when looking at both the qualitative and quantitative data.

The Intended Curriculum

Budget/Check Writing Activity: The intended curriculum for the mathematics lessons was defined by the Sunshine State Standards which provided state mandated guidelines regarding the topics for student instruction in the classroom. These five strands namely number sense, concepts and operations, measurement, geometry and spatial sense, algebraic thinking, and data analysis and probability, comprised the range of topics that were instructed to the students throughout the academic year. The budgeting/check writing hands-on activity in this study utilized two strands, specifically number sense, concepts and operations and data analysis. The researcher hoped to provide the students with a better understanding of the cost of daily living as well as deter illegal activity when the students returned to their home environment.

Cy*linder Activity:* Similarly, the cylinder hands-on activity utilized the geometry and spatial sense strand with an emphasis on prediction and discovery. This activity was also designed to assist students in making choices and working to develop an understanding of why their choice was correct or incorrect.

Implemented Curriculum

Budget/Check Writing Activity: Finding a place to live, paying utilities, calculating car payments, selecting insurance and buying groceries were a few of the areas where these students had to display the ability to handle the basic responsibilities in daily life. The implemented curriculum for this activity revealed that some students would work diligently to find the most economical option whereas others were forced to or chose to go without.

Cylinder Activity: Creating both cylinders, tall and short, required that the students follow written instructions as well as simulate the previously discussed cylinder demonstration. The implemented curriculum provided mental stimulation as the different colour paper cylinders were created by most of the students. However, the implemented curriculum also provided mental confusion as some students could not read the directions correctly to create the cylinder. A tight straw-like version of the cylinder was created instead.

Perceived Curriculum

Budget/Check Writing Activity: The perceived curriculum for the students was mainly about spending money, initially. Students looked through car magazines with plans to purchase a luxury car and reside in a beautiful home until they understood the components. No mention of balancing a budget existed or thought of finding percents was present in these students' minds for this portion of the assignment.

Cylinder Activity: Taping together two different color paper in the form of a cylinder and eating popcorn from each cylinder with both volume comparisons properly documented was all that the students thought dictated successful completion the assignment. Deriving, calculating and explaining an actual formula was never a consideration for them.

Student perceptions of mathematics were assessed with the Test of Mathematics Related Attitudes.

Achieved Curriculum

Budget/Check Writing Activity: Having the students successfully complete all components of the assignment was the achieved curriculum. Within in each component of the assignment several mini-steps were involved. During calculation on the Balancing a Check book worksheet one mistake proved disastrous for the entire assignment creating a need for patience, which is a life skill. The deposit slip required attention to detail as well as basic addition and subtraction skills because students were required to document on the deposit slip an understanding of how to retain a portion of their deposit for themselves. The Budget Worksheet proved to be the most challenging but enlightening portion of the assignment as each student had to account for every dollar received after deciding what they could afford with their individual budget. Because each student received a different amount of money, the quest to balance the worksheet was personal. On the Budget Worksheet the student had to calculate the percentage of their income that was spent on housing, food/clothing/transportation, other fixed expenses, flexible expenses and savings/investments. The final part of the project proved to be the least difficult as the students were required to place those percentages on a circle graph that they constructed by hand versus on the computer. Below the circle graph they were expected to document their personal experiences of trying to live within their budget. Because the assignment was worth four grades, the qualitative components of the assignment held greater importance to the students because of its quantitative component.

Cylinder Activity: The students were able to immediately see that the taller cylinder held less popcorn when they followed the directions provided. Some students were amazed that their predictions were incorrect while others were satisfied that they made a “lucky” choice. Because both sheets of paper were the same size, students expected the same volume. Discovery led to discussion in the classroom about why the difference occurred. Conjectures were made and students were involved. Later calculations and discussion about the actual volume of each cylinder was the desired and achieved curriculum.

3.7 Background and Selection of Sample

The sample size of this study was selected by involving students who participated in the voluntary TOMRA survey. Students were informed that their responses to the survey would have no academic impact on them and that the data was used for research purposes only. Prior to their involvement in the survey, written permission was granted to the researcher from the school district, the principal and the counsellors who acted as legal guardians to the students in the study who resided in this juvenile justice facility. Students who did not complete the entire survey were exempted from participation in the study. Twenty-four students who completed the pre-test were exempt from the study. Five of these students decided that they did not want to participate and the remaining 19 students exited the school prior to administering the post test.

3.8 The Teaching Intervention

Within the regular curriculum, there exists the opportunity to include hands-on activities for the at-risk student. The study utilized this opportunity to include two hands-on activities. Data Analysis, Formulas, Expressions, and Equations, Decimals and Fractions, Geometry and Measurement, Ratios, Rates, and Proportions were introduced and specifically included in the student curriculum. The hands-on activities were incorporated into the topics (see Appendix 1) to be covered. These hands-on activities were implemented within the four months that was allotted for collection of data by the school district. The Budgeting/check- writing activity required five days of class to complete the entire activity. However the Volume of a Cylinder Activity required one day of implementation and 1 day of reflection. Because the students were unable to retain pencils or use the computer without pre-arranged permission from the staff on duty, all work was completed during class time only which had a notable impact on the implementation portion of each activity.

Hands-on Mathematics Activities

Budgeting/Check Writing Project: The students in this study sold drugs to assist with the household income, to finance their personal wants, and to continue their personal drug use. Money for these students was used in part to maintain their lavish lifestyle but the whole picture of financial responsibility was not revealed to them. Many of these students were fathers but did not take the time to understand the required

components of providing for a household. The budgeting project was introduced to these students to provide them with an understanding of all the components of daily living. First, the students were taught how to balance a checking account when provided a given amount of money. During class discussion, students were engaged in conversations to inquire about the meaning of credit, debit, deposit, interest, withdrawals and delinquencies. Prior to the end of class, they were given the first part of their project. It was important to start the project immediately after the discussion to ensure they would recall how to complete the assignment correctly. They were required to balance a check book registry with a large balance and registry components.

During the next class, students were each given a personal check with their names on it and their monthly earnings. All students were anxious to see the amount they received on their check. Every student was given a different amount of money to ensure genuine completion of the assignment. With their check, they received a Budget Worksheet Reference Guide and a Budget Worksheet. The reference guide provided the possible costs for housing, utilities, transportation, and other miscellaneous items that an individual would need to purchase. On the Budget Worksheet, students had to pay for their place to live, pay their utilities, decide on their transportation, pay for their phone, decide on purchasing renter's, medical, dental, and/or life insurance. Deciding on whether an item was a fixed or flexible expense was also a consideration for each student. Because each student had a different amount, students had to provide their own balance sheet. Ten percent of their monthly earnings had to be placed in their savings as a basic requirement. This meant that all students had to know or learn how to find ten percent of their check. Once their entire check was entirely distributed on the budget worksheet, a circle graph of their monthly expenses had to be created. This required that the students change a fraction to a decimal and then to a percent, which was taught in a previous lesson. Numerous apartment shopper and automobile catalogues from the local supermarket provided the students with additional pricing selections as they searched for places to live and vehicles to purchase. This was the second component of the project.

Third, a description of any difficulty in trying to remain within budget had to be written in paragraph form. The students had to discuss why they chose to live in an apartment versus a house and also explain many of the other choices on the budget worksheet. Neatness and organization, as well as the ability to work in the room with others were another component of the grading rubric.

Lastly, an actual bank deposit slip, from a local bank, was provided to each student to practice the correct way to complete a deposit slip. On the next class meeting, the students were provided with another bank deposit slip in order to complete a deposit slip quiz.

Volume of a Cylinder Project: Students were asked to look at two cylinders and decide whether the cylinders held the same amount or one cylinder held more than the other. Each student in the class was asked to make a prediction concerning the volume of the cylinder. They were asked whether the cylinders held the same or the short or tall cylinder held more. Documentation of the responses was placed on the board and they were asked to remember and document the responses on their data sheet. Each pair of students had a rectangular plastic container. Inside the container were two sheets of 8½ x 11 paper one pink and one white, labelled short and tall, a roll of tape, a data sheet, a tape measure and two pencils. During class discussion, students were asked to consider which cylinder they would purchase a product in, if the cost was the same for both cylinders.

With the two identical sheets of paper, the students were instructed to roll one sheet into a short cylinder and the other into a tall cylinder. One student would roll the cylinder while the other student placed the tape on the cylinder to secure it into place. Both cylinders were placed in the rectangular container to allow the student to make visual estimates of the volume of both cylinders. During the student investigation, the instructor informed the students that designers and engineers use visual estimates to find economical ways to package and protect items.

The instructor/researcher drew a circle on the board and reviewed the formula for the area of a circle. Directly following the discussion the circle was changed to a cylinder and the volume of a cylinder was developed and discussed. With the

formula on the board and the cylinders on the desk, the instructor placed popcorn in the rectangular container for all the pairs of students. The students were instructed to compare the volume of the short and tall cylinders, document their findings, and consume the popcorn. However, the activity did not end at that point. The students were required to use the tape measure to compute the actual volume of each cylinder. Calculators were provided for this portion of the project. Later, students were asked to document whether their earlier predictions were correct; consider why some items are packaged in boxes instead of cylinders; and note that some universities offer degrees in packaging technology which could be an occupational choice.

3.9 Quantitative Data Collection Procedures and Analysis

Two quantitative research instruments were used to determine the effects of hands-on mathematics activities on student attitudes and achievement namely the TOMRA and BASI tests. The Test of Mathematics-related Attitudes (TOMRA) was used to assess student's attitudes towards their mathematics class (Fraser, 1981). Similarly, the Basic Achievement Skills Inventory (BASI) was utilized to assess student achievement (Bardos, 1996).

Perception Measures - Test of Mathematics-Related Attitudes (TOMRA)

A mathematics version of Fraser's (1981) Test of Science-Related Attitudes (TOSRA) was revised and called the Test of Mathematics-Related Attitudes (TOMRA). The Australian Council for Educational Research revealed that it was developed, field tested, and shown to be highly reliable. Measuring the attitudes of the students required the use of the international instrument called the Test of Mathematics-related Attitudes namely the TOMRA.

Measuring the attitudes of the students require the use of the international instrument called the Test of Mathematics-related Attitudes namely, the TOMRA. The TOMRA was designed to measure seven distinct attitudes among students. All of the seven scales of the TOMRA, with ten items per scale, were used in this study, resulting in a total of 70 questions. The TOMRA's response format, first described by Likert (1932), required that students express their agreement with each statement on a five-point scale consisting of the responses Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree. TOMRA's major strength was the fact that it provided a

separate score for a number of distinct attitudinal aims instead of a single overall score. Specific attitudinal deficiencies could be identified more readily than with an overall score. I was able to identify the changes in attitude, if they existed, for these at-risk students that received hands-on instruction. The TOMRA scales were Social Implications of Mathematics, Normality of Mathematicians, Attitude to Mathematics Inquiry, Adoption of Mathematics Attitudes, Enjoyment of Mathematics Lessons, Leisure Interest in Mathematics, and Career Interest in Mathematics (see Table 3.1).

Table 3.1 Scales and item examples of the Test of Mathematics Related Attitudes

Scale	**Example of Item**
Social Implications of Mathematics	Money spent on mathematics is well worth spending
Normality of Mathematicians	Mathematicians are about as fit and healthy as other people
Attitude to Mathematics Inquiry	I would prefer to do mathematics problems than read about them
Adoption of Mathematics Attitudes	I enjoy reading about things which disagree with my previous ideas
Enjoyment of Mathematics Lessons	Mathematics lessons are fun
Leisure Interest in Mathematics	I would like to belong to a mathematics club
Career Interest in Mathematics	Working as a mathematician would be an interesting way to earn a living

Achievement Measures - Basic Achievement Skills Inventory (BASI)

The Basic Achievement Skills Inventory (BASI) is a norm-referenced achievement test that measured mathematics, reading and language arts for the students in this study. The mathematics scores will be extracted for use in this study. The BASI series of tests was normed during the 2002-2003 school year and was correlated to the leading individually and group-administered achievement and intelligence tests. This test could be administered using paper and pencil or computer. For the purpose of this study, the test was administered on the computer. The test was organized into four grade-specific levels with two forms for each level. Achilles N. Bardos, PhD, is a Professor of School Psychology at the University of Northern Colorado and is also the author of the BASI. Dr. Bardos co-authored the General Ability Measure for Adults (GAMA) test. The BASI Comprehensive and Survey versions were

standardized on a sample of more than 4,000 students (grades 3 – 12 and college) matched to the 2000 U. S. Census demographic information. The Survey version also was normed on a sample of 2000 adults (ages 18 – 80), matched to the 2000 U. S. Census demographic data. The samples were stratified by race and ethnicity, age, gender, geographical region, and economic status (Bardos, 2006).

The Basic Achievement Skills Inventory (BASI) was a versatile, multi-level, norm referenced achievement test. The BASI test helped measure mathematics, reading and language arts for children and adults. The comprehensive version of the BASI was being used for understanding specific areas of strengths and weaknesses, measuring progress and assisting in diagnosing learning disabilities. BASI was a comprehensive measure of academic achievement for grades 3 – 12 and adults.

The BASI included a summary report and a parent report explaining particular strengths and weaknesses of the students. BASI was used to screen for learning disabilities, inform and diagnose learning disabilities, help determine student readiness for the General Education Development Pre-Test (GED), design learning interventions and other placement decisions, track academic progress and predict performance on high stakes tests. There were two forms of the test, Form A, the fall norms which were administered between August and December and Form B, the spring norms, which were administered between January and July.

Mathematics Computation

What is the decimal representation of 80%?

A) 0.08 B) 0.80 C) 8.00 D) 80.00

If 3n – 5n – 24= 8, then n =

A) -16 B) -8 C) -4 D) 4

4 is a square root of which number?

A) 2 B) 4 C) 16 D) 24

Subtract 15% of 80 from 60% of 25.

A) -30 B) -3 C) 3 D) 30

Mathematics Application

Tony bought 20 raffle tickets at a fire station. The fire station sold a total of 80 raffle tickets. What is the probability that Tony will win the raffle?

A) 40% B) 33% C) 25% D) 20%

For her bedroom, Marisol is buying a rug that is 6 feet by 8 feet. Her room is 9 feet by 11 feet. How many square feet of floor will **not** be covered by the rug?

A) 6 B) 12 C) 24 D) 51

James just bought a car seat that is safe for children weighing up to 40 pounds. James's daughter weighs 24 pounds, 3 ounces. How much weight can she gain and still be safe in her car seat?

A) 15lbs, 7oz B) 15lbs, 13oz C) 16lbs, 3 oz D) 24lbs, 3oz

A cylindrical aquarium is being designed with a base diameter of 5 feet and a height of 6 feet. If 3.14 is used for pi, what is the approximate volume of the aquarium to the nearest cubic foot?

A) 38 B) 118 C) 471 D) 1,884

Figure 3.1 Examples of items in the Basic Achievement Skills Inventory

For the purpose of this study, the pre and post BASI test scores were from Form A. The mathematics subtests consisted of mathematics computation and mathematics application (see Figure 3.1 for examples of items). There were 32 computational problems and 36 application problems. Each subtest could be administered independently. The computational section was 20 minutes long and the application section was 35 minutes long. The BASI testing allowed educators to help students and parents identify strengths and weaknesses in basic skills, to help teachers evaluate their students' achievement, and to help school personnel evaluate program effectiveness.

The results were also used to assist in the placement of students. Student scores on the BASI ranged from 2 to 12.9. A student score of 2 meant that the student was functioning on a second grade level. A score of 7.2 was interpreted as a student who was functioning at the seventh grade second month level. In comparison, a student score of 12.9 was the highest possible score. The interpretation of that score was that the student was functioning at a twelve grade ninth month level. No remediation was suggested and the student needed to be challenged academically in the mathematics classroom.

BASI reports explained how students performed in each content area. The BASI results benefited teachers as well. Teachers used a variety of tests throughout the school year to assess student progress. The information gained as a result of testing was utilized to help educators make sound decisions regarding the instructional program. The questions were all multiple choice. Calculator usage was not permitted; rulers and scratch paper were provided for the student.

Data Analysis Procedures for Quantitative Data

Cronbach alpha was used to determine the reliability of the attitude questionnaire. Pre and post BASI test score comparisons were used to help determine the level of mathematics achievement of each student. The information obtained from these methods was used to explain any differences identified through the statistical analysis of quantitative data. Each student responded to the TOMRA survey and BASI tests. The TOMRA assessed student attitudes towards mathematics. The Test of Mathematics-related Attitudes (TOMRA) (Fraser, 1981) and the Basic

Achievement Skills Inventory (BASI) were the main instruments in collecting quantitative data. Student mathematics achievement was assessed in terms of scores on the BASI test.

3.10 Qualitative Data Collection Procedures and Analysis

The students in this study participated in the implementation of hands-on mathematics activities. Qualitative methods portray an individual or a small number of individuals with a type of ethnological inquiry in a "natural" environment. This method creates a more personal anecdote and allows the reader to become more empathetic towards the subject being researched (Shulman, 1997). The qualitative methods used in this study included post activity student response sheets and observations of mathematics classes. Classroom observations helped to determine student involvement in the hands-on activity. Student output on the post activity response sheet as well as class participation supported student interest in an activity.

Classroom Observations

Budgeting/Check Writing Project: The students in this study were observed as they engaged in the hands-on learning activity. Many students appeared determined to quickly purchase the basic living requirements with their incomes and then move on to spending the remainder of their money on numerous luxuries. However, obvious frustration was observed by the researcher as students complained that their monthly income was not realistic and that too many financial sacrifices had to be made to balance their monthly earnings. Many students questioned why they received more or less money than their classmate, as each student received a different monthly income. All the students in the study understood that one component for successful completion of the entire project required that all of their monthly income was to be documented on their budget worksheet and a circle graph of the expenditures for the month was to be created, explained and attached to their project. A grading rubric, which remained on the classroom wall for constant review, was discussed with the students immediately prior to beginning the assignment. Additional components of the project required that the students balance a check book with entries provided in the registry and finally complete a deposit slip from a bank located in the state.

Cylinder Activity: Most of the students were fully engaged throughout the entire assignment as they were anxious to find out who had the correct theory regarding the volume of two cylinders. The students looked at two different cylinders that were created from the same size paper and prior to the intervention had to decide which container held more or if both containers held the same volume. The John Henry Effect was mimicked as members of the experimental group were provided with a new educational tool and demonstrated a strong competitive drive to solve the problem before their classmate was able to. This was displayed as the activity continued and the students verbally argued about the volume of the container while other students placed bets on the outcome of the experiment. The researcher received inquires by the students about every step of the activity to ensure correct results.

Achievement Measures

Budgeting/Checkwriting Project: Students were informed of the expectations throughout the entire project. The grading scale was posted in the classroom on the wall for all students to observe. An additional reminder of the significant value of class projects was written in the classroom syllabus which also remained on the wall. 85 % of the students received a satisfactory grade for this assignment.

Volume of a Cylinder Project: A satisfactory grade on the assignment was the source of verification of student achievement for this activity. Students had to demonstrate an understanding of how to follow directions, make predictions, derive a formula, and make conjectures on possible uses for items packed in cylinders.

3.11 Summary of Methodology

This chapter discussed the research methodology and provided the research techniques used to collect supporting data to answer each of the research questions. Descriptions of the instruments used and the background of the individuals in the sample were highlighted. The following chapter presents the findings of the collected data. Responses to the research questions were supported using the data collected in the manner explained above. Case studies, quasi-experimental methods, and quantitative data also comprised the findings. The case study approach was used in the investigation to evaluate the effectiveness of hands-on activities when used with at-risk students at a Juvenile Justice Facility.

Chapter 4
RESEARCH FINDINGS

4.0 Overview of the Chapter

This chapter responds to the research questions outlined in this study and reports on the results of the data analysis. Charts, documents, and tables support the findings for many of the questions. Section 4.1 describes the intent of utilizing the hands-on curriculum for the students in the study and section 4.2 describes how the curriculum was implemented and provides samples of the materials used with these students. In section 4.3 reports on the reliability of the Test of Mathematics –Related Attitude questionnaire were discussed while qualitative data regarding student perceptions was provided in section 4.4. Student achievement was reported in section 4.5. Lastly, section 4.6 discussed the associations between student achievement and attitudes when using the hands-on curriculum.

The previous chapter described the methodology used to answer the research questions. Detailed descriptions of the instruments used to collect the data were described, namely the TOMRA and BASI, as well as observations and interviews conducted in an informal setting.

The purpose of this chapter is to report on the findings as a result of the data analysis. This study investigated whether or not hands-on mathematics activities incorporated into the mathematics curriculum for students at a juvenile justice facility resulted in significant improvement in the student's achievement in and attitudes towards mathematics. A pre test was given to the students in this study to provide the baseline academic and attitudinal scores. Hands-on instruction was then utilized in the classroom for three months. Because of the frequent number of entries and discharges at the facility, due to behavioral transfers and legal assignments, the three month semester study was used to ensure the availability of the students for both the pre and post data collection days and activity days.

Comparisons were made to discover the associations between the student achievement and attitudes when hands-on activities were used in the classroom. The budget/check writing and volume of a cylinder mathematics activities used in my

secondary mathematics classrooms at the juvenile justice facility were two of the hands-on activities discussed in this chapter. Reporting in this chapter is divided into six parts with each part corresponding to the research questions indicated below:

1. What is the intended curriculum for Mathematics in this Juvenile Justice Facility?
2. How was the curriculum implemented?
3. Are mathematics scales modelled on the Test of Science-Related Attitudes (TOSRA) reliable when used in secondary mathematics classrooms at a Juvenile Justice facility in South Florida?
4. What were the student's perceptions of the curriculum, particularly their attitudes towards mathematics?
5. What was the achieved curriculum for Mathematics in this Juvenile Justice Facility?
6. Were there associations between student achievement & attitudes when teaching with hands-on activities in secondary mathematics classrooms at a Juvenile Justice facility in South Florida?

4.1 Research Question 1: What is the intended curriculum for Mathematics in this Juvenile Justice Facility?

The Florida Legislature passed HB 349. This bill required extensive reform of Florida's juvenile justice educational programs. State, district and school levels all felt the impact of HB 349 as it established an overall increase in accountability and responsibility. The impact at the state level was to place the accountability for and responsibility of juvenile justice education under the authority of the Department of Education and to establish a mechanism to ensure that research, Quality Assurance, and technical assistance would be conducted to improve the quality of education. Hands-on instructions conducted in the classroom at this juvenile justice facility provided tangible examples to support or refute the funding used to provide materials for these at-risk students. If student scores were statistically significant after participating in the hands-on curriculum at this facility, county wide curriculum adjustments would be recommended. Documentation and submission of the activities' results would be posted in the state's annual QA report. The HB 349 required that research be conducted to identify best practices in juvenile justice

education. At the district level, HB 349 established that the responsibility of the school districts was to oversee the operation of the juvenile justice schools. At the school level, HB349 waived General Educational Development (GED) testing fees, developed academic improvement plans (AIPs) for all students, conducted specific academic record keeping, provided transition services and activities, developed a school improvement plan (SIP), required year-round schooling, and delivered curriculum and instruction to every student based on his or her individual requirements and needs. The legislation provided the beginning of a comprehensive structure and accountability system for Florida's juvenile justice education and a positive outcome for Florida's at-risk youth. Merging interest and academics, two hands-on activities were used in this study to improve the academics scores of at-risk students. On the check writing/budgeting project, the intended curriculum was to provide a real-world activity that incorporated basic mathematics skills. Addition, subtraction, multiplication, percents and graphing were all incorporated into the assignment to reinforce previous skills and provide a purposeful and engaging mathematics experience for each student. On the volume of a cylinder activity, the intended curriculum was to have the students make a visual estimate and find the volume of two cylinders, manually and mathematically.

4.2 Research Question 2: How was the curriculum implemented?

Johnson and Johnson (1989) believed that cooperative student-centered learning techniques engaged and empowered students. Using that theory, my students participated in the hands-on activities while they were in cooperative groups. Their learning partners varied as different tasks were assigned to each group member. Slavin and Madden (1989) believed that the cooperative learning method was the most consistently effective means of increasing student achievement. Because my students are labelled at-risk, successful teaching meant providing and interesting yet challenging curriculum that would encourage completion by the student and foster academic growth by the student. Dewey (1900, 1916, 1938) and Herschbach (1996) stated students indicated that they learned better through hands-on learning methods than through book work or lecture methods. As the assignments were developed, I considered the variety of academic abilities within the class, the student interests, the time required to complete the activities, and the materials needed to complete the activity.

Implemented Lesson

Students sat at a table that allowed four to six students to work. These tables were later used as cafeteria tables when transported daily by the students at the beginning and ending of the class.

During the check writing/budgeting project, the instructor provided the students with an explanation of the parts and purpose of the assignment. A rubric with the specific components of the check writing project was given to each student to use as a guide (see Appendix 2). It was collected from the students and redistributed to the students with a grade after submission of the entire assignment. Students received a personal check that was created for them. No two students had the same dollar amount on their check. Each student received an apartment shopper book and an auto trader magazine which are provided to the public free of charge in the local supermarket. Students were provided with a Budget Worksheet Reference Guide which provided general pricing information about housing, utilities, transportation, and other miscellaneous expenses (see Appendix 3). After deciding on the accommodations that were affordable, students began to complete their budget worksheet (see Appendix 4). Repeatedly students would have to alter choices to account for their monthly budget. The amount each student received on their check would have to be accounted for on the Budget Worksheet to the last penny. Five parts of the Budget worksheet had to be changed into percents with a final total of one hundred percent. Housing was first which included mortgage payments, insurance, utilities, telephone and any other household expenses. The total in this section was the numerator and the amount on their check was the denominator. After documenting this amount, students used a calculator to change the fraction to a decimal. Once complete, the decimal was changed to a percent and documented on the Budget Worksheet next to the housing title (see Appendix 4). The second percent to be calculated was the Food/Clothing/Transportation section which was comprised of food, laundry, and auto loan payments or public transportation costs. The total in this section was the numerator of the fraction and the amount on their check was the denominator of the fraction. Using the calculator, the fraction was changed to a decimal and then to a percent once again. Documentation was submitted next to the Food/Clothing/Transportation title on the Budget Worksheet (see Appendix 4). The remaining three sections labeled other fixed expenses, flexible expenses and savings

and investments required documentation and calculation of a percent also. A final summary of expenses was documented and the total expenses had to equal the amount on each student's individualized check to successfully complete that portion of the assignment. Without a calculator, students were expected to document their understanding of tracking their expenses. Each student was given a Balancing a Checkbook worksheet (see Appendix 5), a pencil and a sheet of paper to provide evidence of their work. Both papers were collected and graded to justify their grade. An authentic bank deposit slip was given to each student to practice making deposits of cash and checks. During next day of class, students were required to demonstrate their understanding of deposit slips by completing all sections of an authentic deposit slip (see Appendix 6) and calculating the amount that they would retain after various transactions. Finally, a circle graph with the five portions from the Budget Worksheet had to be created and colored with a paragraph accompanying the graph. The paragraph had to explain the purpose for each purchase and the level of ease or difficulty the student had remaining within budget.

During the Volume of a Cylinder project, students were in groups of four at each table. The instructor reviewed area of a circle and drew a circle labeling radius, diameter and circumference. Two different colored cylinders were taped to the wall. An explanation of how these cylinders were created was discussed with the students. Each student was asked to make an educated guess, just by looking at both cylinders, to discover if one cylinder held more volume that the other or if they both held the same volume. They were reminded that both cylinders originated from the same type of paper but that they were both rolled differently. Every student response was documented on the board with tally marks for yes they held the same amount or no they held different amounts of volume. A task sheet with student responsibilities was distributed to each table (see Appendix 7). The Volume of a Cylinder procedure sheet was distributed (see Appendices 8 and 9) along with the Volume of a Cylinder response sheet (see Appendices 10 and 11). Each table had a rectangular plastic container with two different colored sheets of paper. These papers were pre-labeled one labeled short and the other labeled tall. A roll of tape and a tape measure were also in the container. Students were required to join the sides of each paper to create short and tall cylinders. After creating the cylinders, the students were provided with popcorn to fill the cylinders and compare whether the containers held the same

amount or different amounts. Three questions were then asked of these students. 1) Which cylinder holds more? 2) How do you know? and 3) Was your group's prediction correct? The manual conclusion was documented and student's discovered what made the assignment unique. Last, the students were required to explain the problem mathematically. They wrote the formula down for each cylinder, measured the radius and height of each cylinder with the tape measure, calculated the actual volume of each cylinder and provided the numerical results of their findings (see Appendices 10 and 11). At the conclusion of the activity, classroom discussion provided acknowledgement of various careers in packing technology and the use of cylinders instead of boxes for packaging different items that are in use (see Appendices 8 and 9).

On the check writing/budgeting project, the students were required to maintain a monthly budget. Each student was given a different monthly income to prevent plagiarism. They were required to document fixed and flexible expenses on a budget worksheet, calculate percents for specified categories within the fixed and flexible expenses, save ten percent of their income in a savings account or investment vehicle, balance a checkbook with fixed entries, complete a deposit slip from a local bank, and manually create a circle graph of their monthly expenses.

On the volume of a cylinder project, students were required to take two identical sheets of paper, roll one paper into a short cylinder and the other paper into a tall cylinder. After placing them both on a flat surface, they were asked to decide whether the cylinders held the same or different amounts when filled. After documenting their individual group members' responses, they used cereal or popcorn to decide what each cylinder would hold. The pre-implementation prediction was discussed within the group to determine if any member of the group arrived at the correct and determine if mathematics played a part in the prediction. Next each student was required to compute the volume of each cylinder mathematically and provide a written explanation of their answer. Additional follow-up questions and facts were provided to the students for discussion after the calculation of the volume for each cylinder was complete.

4.3 Research Question 3: Are mathematics scales modeled on the Test of Science-Related Attitudes (TOSRA) questionnaire reliable when used in secondary mathematics classrooms at a juvenile justice facility in South Florida?

Cronbach alpha reliability coefficients for the pretest and posttest versions for each of the seven TOMRA scales are presented in Table 4.1. The scale reliability estimates range from 0.40 to 0.86 for the pretest form and from 0.22 to 0.74 for the posttest form. The low reliability of the Normality of Mathematicians and Adoption of Mathematics Attitudes means that discussion of these scales should be considered with some caution.

The discriminant validity values (mean correlation of a scale with other scales) for the seven scales of the TOMRA ranged from 0.32 to 0.47 for the pretest form and from 0.27 to 0.41 for the posttest form are also shown in Table 4.1. The data suggest that raw scores on the TOMRA assess distinct but somewhat overlapping aspects of the TOMRA. The results in Table 4.1 support the internal consistency reliability and discriminant validity for five of the seven student attitude scales. The low reliability of the Normality of Mathematicians and Adoption of Mathematics Attitudes limits the use of these scales in this study and any data needs to be interpreted with caution.

Table 4.1 Internal Consistency Reliability (Cronbach Alpha Coefficient) and Discriminant Validity (Mean Correlation With Other Scales) for the TOMRA Pretest and Posttest scores (N = 50)

Scale	Alpha Reliability		Mean Correlation with Other Scales	
	Pretest	Posttest	Pretest	Posttest
Social Implications of Mathematics	0.76	0.54	0.46	0.39
Normality of Mathematicians	0.40	0.22	0.36	0.27
Attitude to Mathematics Inquiry	0.78	0.64	0.36	0.27
Adoption of Mathematics Attitudes	0.47	0.46	0.36	0.30
Enjoyment of Mathematics Lessons	0.86	0.74	0.44	0.41
Leisure Interest in Mathematics	0.78	0.69	0.32	0.31
Career Interest in Mathematics	0.79	0.66	0.47	0.33

4.4 Research Question 4: What were the students' perceptions of the curriculum, particularly their attitudes towards mathematics?

Each student responded to the TOMRA survey without time restrictions. They were instructed to read each question carefully and were assured that their responses would hold no academic penalty but that they were extremely important for the study that they were participating in. One student responded with the same answer for every question without reading the questions because of an unfavorable experience in court. He, later, tore his response sheet in two, requested another form, and honestly re-submitted his responses. All the students in this study responded to the TOMRA survey before implementation of the hands-on learning intervention and again after three months of instruction. Observations were made about the pre/post gains for the students in the study group. (t Test RQ2) The case study consisted of 50 students who participated in the implementation of hands-on mathematics activities. Qualitative data was compiled using the student survey responses and several

observations of the mathematics classes. Visual observations provided additional data to support student involvement in the hands-on activity. Cronbach alpha was used to determine the reliability of the attitude questionnaire.

The ANOVA results for the TOMRA reported in Table 4.2 indicate that, in the posttest, students displayed statistically significant differences (p<0.05) on Social Implications of Mathematics, Normality of Mathematicians, Adoption of Mathematics Attitudes, Enjoyment of Mathematics Lessons than in the pretest. The effect sizes for the five scales for which differences are statistically significant range between approximately one eight of a standard deviation (0.12) and half of a standard deviation (0.52). These results suggest that the magnitude of the differences on these TOMRA scales is large, with students who participated in the posttest consistently having positive attitudes towards mathematics on all sales than those who participated in the pretest (see Figure 4.1).

Table 4.2 Descriptive and inferential statistics (Effect Size and MANOVA Results) on TOMRA

Scale	Average Item Mean		Average Item SD		Difference	
	Pretest	Posttest	Pretest	Posttest	Effect size	T
Social Implications of Mathematics	2.58	2.71	0.59	0.49	0.12	2.30*
Normality of Mathematicians	2.64	2.81	0.39	0.36	0.22	3.17**
Attitude to Mathematics Inquiry	2.64	2.75	0.39	0.56	0.11	1.60
Adoption of Mathematics Attitudes	2.57	2.75	0.45	0.48	0.19	3.40**
Enjoyment of Mathematics Lessons	2.79	3.00	0.81	0.66	0.14	2.17*
Leisure Interest in Mathematics	3.27	3.30	0.72	0.63	0.02	0.26
Career Interest in Mathematics	3.13	3.03	0.67	0.57	0.08	1.22
Algebra Test	5.83	7.39	3.08	2.95	0.52	7.00**

*p<0.05 **p<0.01

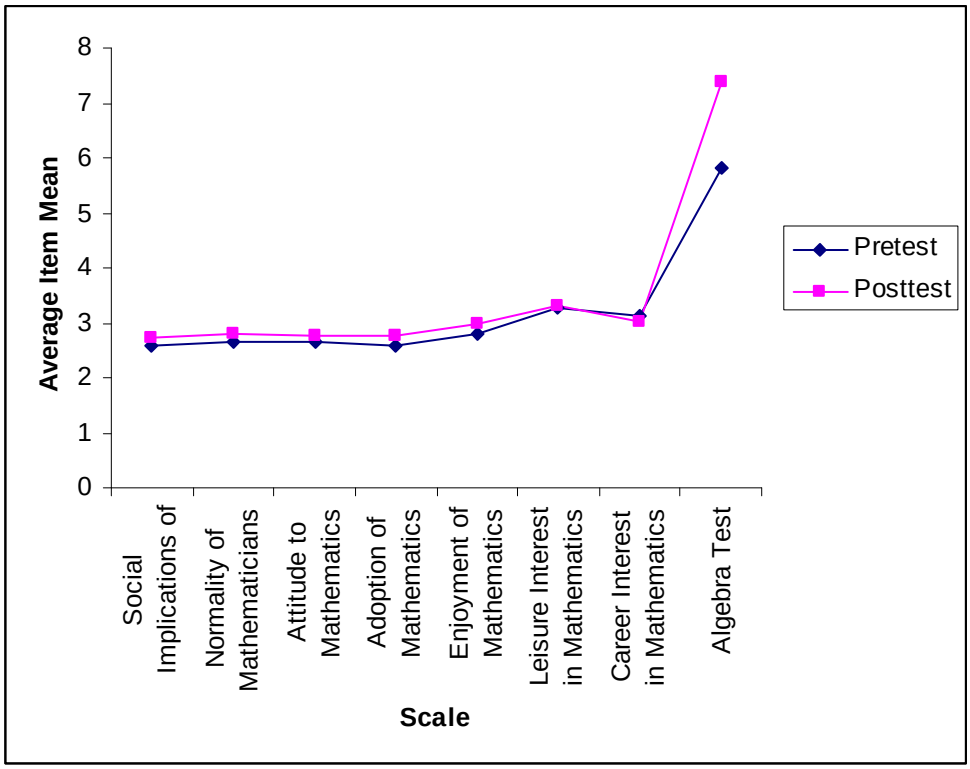


Figure 4.1 Average Item Mean for Pretest and Posttest Scores on the TOMRA Scales

Qualitative data to answer this research question came form classroom observations, informal interviews with students, and document analysis.

Perceived Lesson

Students understood that the check writing/budgeting project would involve the application real world basic skills. They enjoyed the independence of making their selections of wants and needs. Percents, fractions, and paragraph writing was an unexpected part of the assignment that many students mentioned could be omitted. They preferred simple addition and subtraction only.

Creating cylinders and comparing their sizes was the extent of the student expectations of the volume of a cylinder project. They expected that the group activity would be fun because of the hands-on approach which was said to be less stressful than the independent work that standard assessments entail. Many students expected the same paper to produce the same volume regardless of the way the cylinder was created. The manual approach to solving the problem was preferred over the mathematical approach to solving the problem. Because the derivation of the

formula for the volume of a cylinder was discussed, developed, and solved for these two cylinders, the students experienced the comfort of being able to approach future problems. One student stated that he will always remember how to find the volume now that he did the “popcorn thing”. His excitement led me to ask him if he was ready for more volume problems. His response was “Bring it on, I can handle it now!”.

During the introduction of the check writing/budgeting projects, the students were curious about moving away from textbook problems and moving towards real-world problems. The textbook provided students with problem solving questions that students generally disliked and were in fear of. Some apprehension existed during the introduction of this project because the students realized the assignment would weigh heavily on their grade point average as it was worth four grades. Within the assignment, excitement existed when each student received a personalized check and could spend the virtual cash. Finding a car, place to live, and cell phone were the highlights of the assignment. Many students realized the level of difficulty involved when they had to decide what they could afford to purchase. They were able to calculate ten percent without a calculator and became thrilled with their new knowledge. Utility bills and questions concerning basic necessities were discussed with interest and students mentioned that they understood the importance of being able to keep accurate records of their income. They didn’t want to get “robbed” by the system because they could not properly calculate the interest rate or balance their check book.

During the volume of a cylinder project, students continued to express interest in removing themselves from the textbook and getting involved in an activity. “Fun” was the word used to describe filling both cylinders for this activity and making visual comparisons of the volume in each cylinder. Many students expressed comfort with learning through discovery. The concept of volume was demonstrated in a less stressful manner according to these students.

The students detained in this facility retain attitudes towards life that resonate throughout their academic pursuits. Instructors must motivate the students to concentrate on formulas and figures instead of court appointments and family

responsibilities. More than half of the students do not have a genuine interest in mathematics past addition and subtraction. The need to understand algebraic equations in a home environment of drugs, weapons, and family responsibility seemed mindless to these students. However, the data sought to explore the significance of student attitudes before and after the implementation of hands-on instruction in a juvenile justice facility.

Students entered the school by order of the court or by personal request of the parents. Most students arrived to the school in handcuffs and shackles. With parental consent, students, who were referred to as “privates”, were removed from their homes without warning. Private students were defined as students whose parents paid the facility to rehabilitate their child in order to avoid the incarceration of the child, curb drug usage in the home, or prevent the continuation of violent, illegal activity that their child was engaged in. All off-campus appointments, whether it was to go to the doctor or to go to the courtroom, required that the student leave the premises handcuffed, or shackled, or both. On campus, no shackles or handcuffs were used for any other purpose.

Moments after arrival, each incoming student was briefed of the daily schedule, provided with a uniform and sent to the barber to be shaven bald and remove any facial hair that existed. During independent study time, an informal discourse existed between several students and me. These students shared their strengths and weaknesses in mathematics as well as their concerns about events in their life. A resounding quote from the students was “I hate math!” In an effort to further understand their feelings toward mathematics, the students were questioned informally and their responses were recorded in a journal.

The responses to the question “what are your feelings about math?” were the following:

“It’s boring.”

“I didn’t like the teacher because they didn’t explain the work.”

“Math is too hard.”

“I don’t get the letters and numbers thing.”

“I ain’t gonna use this kinda math in the streets, yah feel me?”

“Math___ I can do it but I don’t feel like it. (doing math).”

“You get asked some crazy questions in math.”

“Takes too long to get ***one*** answer.”

Figure 4.2 The responses to the question “what are your feelings about math?

The hands-on activity used in this study to develop student understanding of the volume of a cylinder resulted in various responses. The cylinder activity required that a pair of students create two cylinders with two different colored 8.5inch x 11inch sheets of paper. One cylinder was created with a height of 11inches. The other cylinder created with a height of 8.5 inches. After filling the cylinders with popcorn that was provided to them, the students had to speculate which cylinder held the most volume, develop a formula for the volume, find the actual volume, and reveal whether their speculation was correct. A four question reflection sheet was given to each student at the conclusion of the activity. Students were asked to name three parts of the activity that they liked and disliked, identify a portion of the activity that they would like to see changed, and name a mathematics activity that they would like to engage in during class. The responses documented by several of the students are presented in Figures 4.2, 4.3 and 4.4.

Name three parts of the activity that you liked. And why?

"the simplicity of the activity"

"working on hands-on stuff"

"it was a group activity"

"it was fun to do"

"playing with cylinders"

"trying to create the cylinders"

"the measuring was fun"

"trying to put the cubes in the cylinder"

"I liked how the two were the same yet different"(papers that created the 2 cylinders)"

"filling the cylinder because it kept me occupied"

"It proved a point, it actually made you think and it proved me wrong"

"It taught something new in a less stressful way"

Figure 4.3 Responses to: Name three parts of the activity that you liked. And why?

Name three parts of the activity that you disliked. And why?

"explaining the volume and doing the worksheet"

"doing the writing"

"too much work"

"it was too short" (activity)

"my prediction was wrong"

"we only used one shape"

"too many parts to get to the answer"

Figure 4.4 Responses to: Name three parts of the activity that you disliked. And why?

What would you change about the activity?

"have candy to fill the cylinders"
"have metal cylinders instead"
"do the activity by myself"
"I don't know and I don't care"
" the write (writing) part, I don't like to write"
"I would have use different kind of shapes to measure instead of using only a cylinder "
"fractions"
"math hangman"
"brain twisters"
"I would like to do some building structure; how much weight a building can take and such "
"building different stuff with math use" (using math to build)
"calculus "
"suduko"
"It doesn't matter to me"
"Division so I could learn more about it "
"Multiplication and division "

Figure 4.5 Responses to: What would you change about the activity?

4.5 Research Question 5: What was the achieved curriculum for Mathematics in this Juvenile Justice Facility?

However, the BASI test used in the study supports a positive correlation when considering the use of hands-on activities to improve the standardized test scores of the students at this juvenile justice facility. Quantitative data from this case study supports the conjecture that the differences between the pre and post BASI test scores were statistically significant after engaging the students in hands-on activities. It further reveals that there was a 95% probability that the differences were not due purely to chance (Table 4.2). Attitude to Mathematics Inquiry, Leisure Interest in Mathematics and Career Interest in Mathematics are revealed in Table 4.2 to have statistically insignificant changes for my students on the attitude questionnaire. However, the academic impact was notable on Table 4.2 as difference in the pre-test and post-test reveal.

In the check writing/budgeting assignment, students were able to see the usefulness of mathematics in daily life. Understanding how to calculate percent, changing a portion of their income into a fraction and decimal was achieved and reinforced throughout the assignment. The importance of surviving within a budget was realized when the student requesting more money to maintain their monthly budget but realized that their income could not be supplemented. Students shifted portions of their income to accommodate their needs and learned to calculate the percents for portions of their expenses until they could account for one hundred percent of their monthly income. Frustration developed when their budgets totalled ninety percent, determination was displayed as they focused on re-calculating the entire budget, and diligence was rewarded when they successfully documented one hundred percent of their income which was the achieved curriculum for the assignment.

During the volume of a cylinder activity, students saw the progression of previous concepts develop into their current activity. This was demonstrated as the area of a circle was discussed prior to the volume of a cylinder activity. Connections to the area of a circle and the volume of a cylinder were demonstrated to the students through drawings and then reinforced within the activity. As the students used the tape measure to document the radius and height of the cylinder within the assignment, students were able to support their discoveries mathematically. Students mentioned that the pictures from the textbook “came to life”. Three-dimensional drawings in the textbook could be touched and explored to determine the solution to problems involving volume of a cylinder.

Achieved Lesson

In the check writing/budgeting project, students worked with an important concept within the mathematics curriculum namely fractions. Moving from fraction to decimal to percent required the comfort of understanding the process. Mastery of this process was achieved as the students had to manipulate their data in order to balance their monthly budget. After numerous attempts, the students were successful and then had to convert their figures to percents. Considerations of their purchases had to be made and a life lesson was experienced during the decision making process. Because circle graphs are used to represent parts of a whole, students displayed every part of their monthly income on a circle graph and discussed the appropriateness of

using that type of graph versus a line graph or bar graph. Many students were elated when they realized that they were working with authentic bank deposit slips. Some students jokingly wanted to retain their deposit slips to present to the bank upon their release.

During the volume of a cylinder project, students understood that the short cylinder had the greater volume as they moved from their visual estimates to the discovery using popcorn. Once the tall cylinder was placed inside the short cylinder and filled with popcorn, the students had the "a ha" moment when the tall cylinder was lifted out of the short cylinder and they could "see " the contents fall into the short cylinder. Because the short cylinder did not fill up, the students understood the short cylinder could hold more volume. One student mentioned "it proved a point, it actually made you think, and it proved me wrong". Students mentioned that they enjoyed the simplicity of the beginning of the assignment, the ability of the assignment to prove to them what the answer was, and the opportunity to eat popcorn during mathematics class.

4.6 Research Question 6: Were there associations between student achievement and attitudes when teaching with hands-on activities in secondary mathematics classrooms at a Juvenile Justice facility in South Florida?

The results of simple correlation analysis shown in Table 4.3 indicate that only the Normality of Mathematicians scale is negatively and statistically significant ($p<0.05$) and negatively related to Cognitive Outcomes. The results of the simple correlation analysis suggest that improved student outcomes are associated with more emphasis on this scale.

The multiple correlation (R) between students' attitudes and the TOMRA scales reported in Table 4.3 is 0.32. Standard regression weights were inspected to provide information about the unique contribution of each attitude scale to Cognitive Outcomes when the six scales mutually controlled. However, as shown in Table 4.3 none of TOMRA scales is a significant independent predictor of Cognitive Outcomes.

Table 4.3 Simple correlation (*r*), multiple correlation (*R*) and standardized regression coefficient (*Beta*) for association between students' attitudes towards mathematics and posttest cognitive outcomes (N = 50)

TOMRA Scales	Strength of Students' Outcomes-Attitude Association	
	Cognitive	
	r	*Beta*
Social Implications of Mathematics	-0.71	0.06
Normality of Mathematicians	-0.27*	-0.25
Attitude to Mathematics Inquiry	-0.08	-0.01
Adoption of Mathematics Attitudes	-0.11	-0.01
Enjoyment of Mathematics Lessons	-0.06	-0.07
Leisure Interest in Mathematics	0.05	0.22
Career Interest in Mathematics	-0.15	-0.20
Multiple correlation (*R*)	0.32	

*$p<0.05$

4.7 Conclusion

This chapter presented the findings of this study by addressing each of the research questions individually. Both quantitative and qualitative data obtained from the *Test of Mathematics Related Attitudes,* the *Basic Achievement Skills Inventory*, and observations of and interviews with the students were presented in this chapter. The discussion of these findings is presented in Chapter 5.

Chapter 5
DISCUSSION AND CONCLUSION

5.0 Overview of the Chapter

The purpose of this chapter is to provide an overview of the thesis by summarizing each of the chapters. Section 5.1 contains the overview and discussion of the findings of the study as it pertains to students' attitudes is presented in section 5.2. Further discussion of the outcome of the hands-on activities in relation to student achievement is presented in section 5.3. Next, discussion of the association between achievement and attitude when teaching hands-on activities at a Juvenile Justice facility is presented in section 5.4. The implications of the approach and significance of the study are discussed in section 5.5. The limitations of the study and the recommendations for future research and suggestions for success of all at-risk students whether they are detained at a Department of Juvenile Justice facility or traditionally educated are described in sections 5.6 and 5.7, respectively.

The previous chapter finalized the results and discussion of the intended curriculum (Research Question 1), the implemented curriculum (Research Question 2), and the reliability of the modified Test of Mathematics related Attitudes in this special learning environment (Research Question 3). In this chapter, the results are further discussed regarding student attitudes towards mathematics as a result of using the hands-on mathematics activities (Research Question 4), student achievement in mathematics as a result of using the hands-on mathematics activities (Research Question 5), and associations between students' attitudes and achievement (Research Question 6).

5.1 Overview of the Thesis

Chapter 1 discussed a brief history of hands-on instruction in the United States and its previous impact on educational programs. Section 1.4 provided a description of the participants in the study and Section 1.5 provided the purpose for the study. Section 1.6 demonstrated the purposes of the study and section 1.7 provided an overview of the research design. The quasi-experimental method used in this case study was provided along with an explanation of the manner with which the

quantitative and qualitative data was collected. Lastly section 1.8 provided the limitations of the study.

Chapter 2 reviewed the literature associated with the study. Four areas were discussed in this chapter specifically the juvenile justice system, the at-risk student, the hands-on activity's effectiveness and the hands-on activities unique to the study. Section 2.2 provided detailed information about the context of the State of Florida's Department of Juvenile Justice and later the Miami-Dade county's Department of Juvenile Justice which is the location where my study took place. A discussion regarding the minority population in the Department of Juvenile Justice system was provided. Section 2.3 described the demographics of funding for the state as well as the student population for the state. A definition of the at-risk student was provided in section 2.4 with support for cooperative learning methods being effective in increasing student achievement. In this study, I investigated whether the student achievement was significantly affected when using these cooperative learning methods with students at a juvenile justice facility in South Florida. Finally section 2.5 provided the connection between hands-on activities and at-risk student success in the classroom. Authentic learning was defined and discussed to provide further rationale for the purpose of the study. In this study, I investigated whether the hands-on activities were more effective than lecture in terms of student attitude and achievement for students detained in a South Florida Juvenile Justice Facility. Authentic learning techniques used in this study were introduced. The research was shown to support the use of opportunities for learning and practicing basic skills through the use of authentic tasks as essential skills for at-risk students.

Chapter 3 discussed methodology used in the present study. A description of the research problem and an outline of the research questions of the study were described in section 3.1. The context of the study was discussed in section 3.2. A detailed description of the location of the study and the participants in the study were provided in this section. Further information was provided in section 3.3 where the student environment was described. Daily activities were discussed to provide a necessary view of the students' daily routine as it related to student attitudes in the classroom. Section 3.4 described the study groups' ages and abilities within the classroom and also displayed a snapshot of the academic ranges within the classroom

along with the classroom setting for instruction. In section 3.5, I explained the research design used to answer the research questions. The method of collection of the qualitative data for the study was discussed. The theoretical framework used by Treagust (1987) was adopted for use in this study. In Section 3.6 the intended, implemented, perceived, and achieved curriculum framework was used as the study's template because it provided a complete approach to display the all aspects of the teaching within the study.

Section 3.7 detailed the background and selection of the study sample size. In Section 3.8 the teaching intervention, including both hands-on activities used with these at-risk students was also described in this section. Dewey (1900) believed that, through hands-on activities, students could combine intellectual stimulation with activities that expand learning. Both research instruments, namely the TOMRA and BASI tests, were discussed in section 3.9 to provide an understanding of how the quantitative data was collected. A mathematics version from Fraser's (1981) Test of Science-Related Attitudes (TOSRA) was revised, called the Test of Mathematics-Related Attitudes (TOMRA), and used to assess student attitudes towards mathematics. The Basic Achievement Skills Inventory, (Bardos 1996) was used to assess student achievement of mathematics. Samples of both instruments were provided in this section. Qualitative data collection procedures and analysis, as well as classroom observations and the achievement measures were provided in section 3.10. A summary comprised section 3.11.

Chapter 4 provided analysis and results of the quantitative data. The data gathered from the 50 students was statistically analyzed to provide information about the validity and reliability of the revised attitude instrument named the TOMRA. The intended and implemented curriculums in this study were discussed in sections 4.1 and 4.2, respectively. Section 4.2 provided a snapshot of the student environment with the results of the attitude instrument in sections, 4.3 and 4.4. Student perceptions of both hands-on curriculum activities, specifically as they pertained to their attitudes towards mathematics, and the achieved curricula were discussed in sections 4.4 and 4.5, respectively. Section 4.6 discussed whether there were associations between student outcomes (achievement and attitudes) when they were taught with hands-on activities for at-risk students. Section 4.6 sought to describe

whether associations between student outcomes (achievement and attitudes) and improved standardized test scores for the students. Section 4.6 continued to described how both hands-on activities were implemented, perceived and achieved. Lastly section 4.7 provided the conclusion.

5.2 The focus of Research Question 4 in terms of attitudes becomes: Was there a significant improvement in student attitudes towards mathematics as a result of using the hands-on approach to learning?

From Table 4.1, in section 4.4, the results support the internal consistency reliability and discriminint validity for the seven attitude scales. The results of the revised version of the TOMRA were valid and reliable and the same data gathered from the 50 students was statistically analyzed using the analysis of variance (ANOVA) to determine the difference between the pre and post test TOMRA scores. Normally this statistical procedure is conducted on two different groups. A one-way ANOVA is used when the objects are subjected to repeated measures and the same subject is used for each treatment. In my study, the same subjects (50 students) participated in hands-on activities and were pre and post tested. These sets of data were also statistically analyzed using simple correlation analysis to determine if associations exist between the TOMRA and cognitive outcomes for these at-risk students in their mathematics class. The results indicated that improved student outcomes are associated with more emphasis on the Normality of Mathematicians (Chapter 4, Table 4 3). The multiple correlations for the set of seven attitudinal scales indicates that none of the TOMRA scales is a significant independent predictor of cognitive outcomes (Chapter 4, Table 4.3)

During the classroom observations, I noticed that the students were absorbed in their tasks. Several grade levels were instructed in the same classroom where an individualized curriculum was a requirement and basic right for each student. Varying levels of academic maturity was satisfied within these activities. These student-paced activities allowed students the freedom of exploration to arrive at the answer and removed the embarrassment associated with asking questions within a lecture setting. Subject specific questions were being asked by the students as they demonstrated an interest in arriving at the final outcome. All the students improved their grades by participating in these hands-on activities. Students who were

receiving D and F scores on quizzes performed at least one letter grade higher on the hands-on activity. The exploration and success with these activities fostered greater confidence and higher motivation levels in these students. The reflection sheet completed at the end of each activity overwhelmingly revealed that students were requesting the opportunity to complete additional hands-on activities.

5.3 The focus of Research Question 5 in terms of achievement becomes: Was there a significant improvement in student achievement in mathematics as a result of using the hands-on mathematics approach to learning?

Regarding significant improvement between the use of hands-on mathematics activities in mathematics classes, the finding indicate that in the post test positive and statistically significant correlations exist between the use of hands-on learning activities and student achievement (Chapter 4, Table 4.2). Overall, there was a much stronger association with hands-on learning activities existed for student' achievement than for students' attitude.

5.4 The focus of Research Question 6: Were there associations between student achievement & attitudes when teaching with hands-on activities in secondary mathematics classrooms at a Juvenile Justice Facility?

Associations existed between achievement and attitudes for these students as a favourable experience in the classroom motivated students to pursue the solution to a mathematics problem within the hands-on activity. When mathematics problems were presented without the activity, students exhibited a decline in diligence to search for the solution, be it correct or incorrect. Improved attitudes fostered improved grades in the classroom.

5.5 Implication and Significance of the Hands-on Mathematics Approach

From this study, I concluded that the use of hands-on mathematics activities improved attendance because students were anxious to get to class to use the materials. It provided authentic tasks for my students and encouraged students to pursue furthering their education instead of returning to a life of crime. The sampling of at-risk students from several counties in South Florida provided the opportunity for statewide comparisons to be made regarding at-risk students. The findings indicate that a curriculum change should be incorporated into the state's curriculum

for at-risk students to include a greater use of hands-on activities to improve their academic achievement.

To foster a more productive society, schools must increase their output. Hands-on, cooperative, authentic tasks in schools improved school attendance. A study regarding the reasons why at-risk students' remained in school was performed by Power (1984) who found that at-risk student's individual achievement level and academic performance was directly related to the student's decision to remain in school. Corbett and Wilson (2004) reported on a survey of low-income students which revealed that students value teachers who are able to teach in multiple ways. At-risk students who remain in school clearly are provided with alternatives in many facets of their lives. Financial options are changed and a new perspective is provided for these students as they can envision a possibility of life without crime for survival. Vocational options are encouraged through the use of hands-on instruction, as many of these students may not have an opportunity to further their education past high school. Instruction that includes hands-on activities and cooperative groups has been associated with increased academic performance (Taylor, 2000).

The study indicated that there was a significant increase in the academic performance of these at-risk students. Post test scores suggest that the hands-on curriculum was successful as the academic test scores increased by 27% (See Table 4.2).

5.6 Limitations of the Study

This case study was limited to at-risk male students detained in a juvenile justice facility and the findings can only be generalized to this site. However, these findings provided some similarities to at-risk students' results from previous research data that also strengthen the results in this case study. Previous research reveals that effective teachers of at-risk students must instruct students using multiple methods of instruction to encourage interest and improve achievement.

The qualitative portion of the study required that unscheduled interviews be allowed to facilitate the collection of unbiased data. Quantitative data were subject to student attendance which varied due to court appointments, medical appointments, student

discharges or student illnesses. These mandatory student appointments made the collection of data partially challenging.

Fifty students were able to participate in this pre-post case study. However, abnormalities with the juvenile justice program prevented the maintenance of a larger sample size. Students were discharged at any time during the year, per the Judges orders, to return to their home environment after completing the time they were required to serve. This resulted in student leaving the school at anytime, irregardless of the schools academic calendar. During a portion of my case study, all the students were quarantined for two days due to a severe stomach virus which later was documented as being caused by fecies in the food. One student that tested positive for TB was housed amongst the other students creating an uncomfortable classroom setting for the entire class. Many of the students that were ill would be sent to class draped in a blanket. Ten percent of the student body was on crutches due to football injuries or scheduled surgeries. Also new students arrived weekly and veteran student were discharged weekly. These irregularities decreased the sample size and created an eventful data collection process.

5.7 Recommendations and Suggestions for Future Research

Future researchers are recommended to conduct a case study of female at-risk students detained in a juvenile justice facility to discover if gender specific correlations exist between hands-on activities and student outcomes (attitudes and achievement).

Also research should be conducted in all four core classes namely Language Arts, Social Studies, Science and Mathematics. Students in at-risk classes in a traditional school setting should also participate in a research study.

Comparisons should be made to determine what type of similarities and differences exist between detained at-risk students and traditionally schooled at-risk students.

Another means of gathering purposeful data would be to train at-risk teachers to their students using solely project based hands-on assignments. Previous finding claim that student retention increases when authentic tasks are incorporated into the

curriculum. These future case studies would provide critical data with which comparisons to existing data could be made. Findings from these comparisons could encourage the production of a new, more effective curriculum for at-risk students. Further research should include state and national comparisons of at-risk students' retention, attitude and achievement when hands-on activities are incorporated into the curriculum.

REFERENCES

Adolphe, G.F., Fraser, B.J., & Aldridge, J.M. (2003, January). *A cross-national study of classroom environment and attitudes among junior secondary science students in Australia and Indonesia.* Paper presented at the Third International Science, Mathematics and Technology Education Conference, London, South Africa.

Ainley, J., Batten, M., & Miller, H. (1984a). Patterns of retention in Australian government schools (ACER Research Monograph No. 27). Hawthorn, Victoria.

Ainley, J., Batten, M., & Miller, H. (1984b). Staying at high school in Victoria. (ACER Research Monograph No. 23). Hawthorn, Victoria.

Ainley, J., Foreman, J., & Sheret, M. (1991). High school factors that influence students to remain in school. *The Journal of Educational Research, 85*(2), 69-80.

Akindehin, F. (1993). An investigation of some factors of psychosocial environment in some Nigerian secondary schools. *Research in Science & Technological Education, 11*, 117-126.

Aldridge, J.M., & Fraser, B.J. (2000). A cross-national study of classroom environments in Taiwan and Australia. *Learning Environments Research: An International Journal, 3,* 101-134.

Aldridge, J.M., Fraser, B.J., & Huang, I.T.C. (1999). Investigating classroom environment in Taiwan and Australia with multiple research methods. *Journal of Educational Research, 93,* 48-62.

Anderson, G. (1998). *Fundamentals of educational research* (2nd ed.). Brisol, PA: Falmer Press.

Bardos, Achilles (2006). Basic Achievement Skills Inventory. Retrieved June 15 2006 from website:http://www.pearsonassessment.com

Basche, C. (1985). The high school drop out: Vocational education can help. Normal. IL: Illinois State University. (ERIC Document Reproduction Service No. ED 262 213)

Boutin, F., & Chinien, C.A. (1998). Retaining at-risk students in school using a cognitive-based instructional system: Teachers' reflection in action. *Journal of Industrial Teacher Education, 36*(1), 62-78.

Cardon, P. (2001). At-risk students and technology education: A qualitative study. *The Journal of Technology Studies, 26*(1), 1-16.

Corbett, D. & Wilson, B. (2004). What urban students say about good teaching. *Educational Leadership, 60*(1), 18-22

Clark, Coral (2005). Experience is the Best Teacher. Retrieved June 19, 2005 from website: http://www.raft.net

Day, S. (2002). Real kids, real risks: Effective instruction of students at risk of failure. *Bulletin, a Journal for the National Association of Secondary School Principals,* September Issue, *86*(632), 19-32.

Day, S. (2000). Perceptions of At-Risk Middle School Students, Teachers, Parent and Administrators Concerning the Motivational Elements of the Synergistic System, A Synopsis of Study Review by Brenda Le Tendre, Ed.D.

Denavas, W.C., Proctor, B.D., & Lee, C.H. (2006). *Income, poverty, and health insurance coverage in the United States: 2005.* Washington, DC: U.S. Census Bureau. Retrieved October 31, 2006, from http://www.census.gov/prod/2006pubs/p60-231.pdf.

Denzin, N.K., & Lincoln, Y.S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Dewey, J. (1900). The school and society. (13th ed.). Chicago: The University of Chicago Press.

Dewey, J. (1916). Democracy and education. New York: MacMilllan.

Dewey, J. (1938). Experience and education. New York: Collier.

DiCintio, M.J., & Gee, S. (1999). Control is the Key: Unlocking the motivation of at-risk students. *Psychology in the Schools*, *36*(3), 231-237.

Dunn, R., Dunn, K., & Price, G.E. (1989). *Learning style inventory (LSI).* Lawrence, KS: Price Systems, Inc.

Fraenkel, J.R., & Wallen, N.E. (1996). *How to design and evaluate research in education.* New York, N.Y.: McGraw-Hill, Inc.

Fraser, B.J. (1981). *TOSRA: Test of Science-Related Attitudes Handbook*. Melbourne: The Australian Council for Educational Research Limited.

Fraser, B.J., & Chionh, Y.-H. (2000, April). *Classroom environment, self-esteem, achievement, and attitudes in geography and mathematics in Singapore.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Goh, S.C., & Khine, M.S. (Eds.). (2002). *Studies in educational learning environments: An international perspective.* Singapore: World Scientific.

Gokhale, A.A. (1996) Effectiveness of computer simulation for enhancing higher order thinking. *Journal of Industrial Teacher Education, 33*(4), 36-46.

Grouws, D. & Cebulla, K. (2000). *Improving student Achievement in Mathematics*. Geneva, Switzerland: International Academy of Education International Bureau of Education Educational practices Series -4.

Herschbach, D.R. (1996). On the proposition that technology education leaders have neglected important qualities of industrial arts education. *Journal of Technology Studies, 22*(2), 4-14.

Ilmer, S., Snyder, J. Erbaugh, S., & Kurtz, K. (1997). Urban educators' perceptions of successful teaching. *Journal of Teacher Education, 48*(2), 379-384

Johnson, D.W., & Johnson, R.T. (1989). *Leading the cooperative school*. Edina, MN: Interaction

Khoo, H.S., & Fraser, B.J. (1998, April). *Using classroom environment dimensions in the evaluation of adult computer courses.* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Kilpatrick, J., Swafford, J., & Findell, B. (2001). The strands of mathematical proficiency. *Adding it up: Helping children learn mathematics*. Washington, DC: The National Academies Press.

Letgers, N., McDill, E., & McPartland, J. (1993). Section II: Rising to the challenge: Emerging strategies for educating students at-risk. In *Educational reforms and students at-risk: A review of the current state of the art* (pp. 47-92). Retrieved June 6, 2002, from U.S. Department of Education, Office of Educational Research and Improvement website http://www.ed.gov/pubs/EdReformStudies/EdReforms/ chap6a.html

Mathison, S. (1998). Why triangulate? *Educational Researcher, 17*(2), 13-7.

McCann, R.A., & Austin, S. (1988). *At-risk youth: Definitions, dimensions and relationships.* Philadelphia, PA: Research for Better Schools Inc. (ERIC Document Reproduction Service No ED 389 780)

Means, B. (1997). Critical issue: *Using technology to enhance engaged learning for at-risk students*. Retrieved June 6, 2002, from North Central Regional Educational laboratory website: http://www.ncrel.org/sdrs/areas/issues/students/atrisk/as400.htm

Means, B., Chelever, C., & Knapp, M. (Ed.). (1991). *Teaching advanced skills to at-risk students: Views from research and practice.* San Francisco: Jossey-Bass.

Means, B., & Olson, K. (1995, April). *Technology's role within constructivist classrooms*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco. (ERIC Document Reproduction Service No. ED 383283).

Midkiff, R.B. (1991). Learning style needs of at-risk students: teaching math and social studies the way they learn. (ERIC Document Reproduction Service No. ED 331 632)

Mentoring Minds (2008). *Research Documentation: Research: Motivation Math.* Retrieved March 10, 2008 from website: http:www .mentoringminds.com/research/researchMMath.html

No Child Left Behind. (2001). Washington, D. C.; U. S. Department of Education.

Ogle, D. (1997). *Critical issue: Rethinking learning for students at-risk.* Retrieved June 6, 2002, from North Central Regional Educational Laboratory website: http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at700.htm

Power, C. (1984). Factors influencing retentivity and satisfaction with secondary schooling. *The Australian Journal of Education, 28*(2), 115–125.

Resnick, L. (1987). *Education and learning to think.* Washington, DC: National Academy Press.

Shulman, L.S. (1997). Disciplines of inquiry in education: A new overview. In R.M. Jaeger (Ed.), *Complementary methods for research in education* (2nd ed., pp. 3-29). Washington, DC: American Educational Research Association.

Slavin, R.E., & Madden, N.A. (1989). What work for students at risk: A research synthesis. *Educational Leadership*, *46*(5), 4-13.

Stigler, J. & Hiebert, J. (2004). Improving Mathematics teaching. *Educational Leadership, 61*, 12-17.

Stronge, J.H., Popp, P.A., & Grant L.W. (2007). Effective Teachers of At-Risk and Highly Mobile Students: A Review of Literature *Technical Report Submitted to National Center for Homeless Education*

Swarts, L. (Ed.). (2002). A preliminary investigation of alternative education programs in Kentucky. Louisville, KY.

Taylor, B.M., Pearson, P.D., Clark, K., & Walpole, S. (2000). Effective schools and accomplished teachers: Lessons about primary-grade reading instruction in low-income schools. *The Elementary School Journal*, *101*(2), 121-165.

Taylor-Dunlop., K. & Norton, M.M. (1997). Out of the mouths of babes: Voices of at-risk adolescents. *The Clearing House*, *70*(5), 274-278.

United States Census Bureau. (2004). *Small area income and poverty estimates.* Retrieved November 15, 2006 from http://www.census.gov/cgi-bin/saipe/national.cgi?year=2004&ascii=#SA51.

Appendix 1

Curriculum Topics

Curriculum Topics

1. Interpreting Graphs
2. Making Bar Graphs
3. Line Plots and Stem-and-Leaf Diagrams
4. Mean, Median, Mode, and Range
5. Line Graphs
6. Scatterplots
7. Formulas and Variables
8. Order of Operations
9. Formulas and Tables
10. Translating Words to Expressions
11. Comparing and Ordering Fractions
12. Converting Between Fractions and Decimals
13. **Budgeting/Check-Writing Project**
14. Comparing and Ordering Decimals
15. Estimating by Rounding
16. Problem Solving with Sums and Differences of Decimals
17. Problem Solving with Product and Quotients of Decimals
18. Solving Addition and Subtraction Equations
19. Powers of 10 and Scientific Notation
20. Solving Multiplication and Division Equations
21. Problem Solving with Two-Step Equations
22. Equivalent Fractions and Lowest Terms
23. Adding and Subtracting Fractions
24. Multiplying and Dividing Fractions
25. Angles
26. Perimeter and Area
27. The Pythagorean Theorem
28. Areas of Triangles
29. Areas of Parallelograms and Trapezoids
30. Circles and Circle Graphs
31. Pi and Circumference
32. Area of a Circle

33. **Volume of a Cylinder Project**
34. Volume of Cylinders
35. Percents
36. Linking Fractions, Decimals and Percents
37. Finding a Percent of Number Mentally
38. The Coordinate Plane
39. Adding and Subtracting Integers
40. Multiplying and Dividing Integers

Appendix 2

Rubric

Math – Problem Solving: Check Writing

CATEGORY	**4**	**3**	**2**	**1**
Deposit Slips	All of the following are correct: Name: Account number; Date: Deposit section; Signature	One item missing/incorrect from deposit slip.	Two items missing/incorrect from deposit slip.	Three items missing/incorrect from deposit slip.
Budget Table	All of the following are correct: Fixed Expenses; Flexible Expenses; Savings Investments.	One component missing/incorrect from Budget table.	Two components missing/incorrect from Budget table	Three components missing/incorrect from Budget table
Balancing a Checkbook	21 – 23 correct entries in registry	20 -18 correct entries in registry	16 – 17 correct entries in registry	15 – 14 correct entries in registry
Illustration and Description (graph required)	Picture and paragraph are clear and greatly add to the reader's understanding of the purchase of the product.	Picture and paragraph are clear and easy to understand.	Picture and paragraph are somewhat difficult to understand.	Picture and paragraph are difficult to understand or are not used.
Neatness and Organization	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read.	The work is presented in an organized fashion but may be hard to read at times.	The work appears sloppy and unorganized. It is hard to know what information goes together.
Working with Others	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson	Student was an engaged partner but had trouble listening to others and/or working cooperatively	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.

Student Name_____ *** Worth **4 grades** ***

Appendix 3

Budget Worksheet Reference Guide

Budget Worksheet Reference Guide

Housing

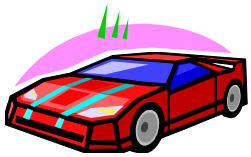
3 Bedroom house: $1400/per month
1 Bedroom apartment: $750/per month
Studio apartment: $600/per month
Renter's insurance: $150/per month
Homeowner's insurance: included in mortgage

Miscellaneous

Cell phone: $48.50 /per month
Cable: $50.54 - $84.42/per month
Food: a minimum of $64/per week
Laundry: If in an apartment YOU MUST PAY THIS:
$24/per week ($1.00/wash; $1.00/dry; avg: 3 loads per wk)
** If a homeowner DO NOT PAY Laundry Costs !!

Utilities

Florida Power and Light: $84.64 - $134.64/per month
Water (for homeowner's only/apartment renters do not pay):
$82.76/per 3 months
Telephone (Bell South): $53.12 - $83.12/per month



Transportation

*** Find the amount of the monthly payment of the car of your choice.
Car Insurance: $100 – 180 per month/per vehicle
* Don't forget to budget for gas!
If you don't own a car, you must use Public Transportation, $1.25 each way

Appendix 4

Budget Worksheet

Ms. L. Carter
Check Writing/Budgeting Project

BUDGET WORKSHEET

FIXED EXPENSES

Housing = _____%
Mortgage payment $_____
Real Estate taxes $_____
Homeowners insurance $_____
Rent Expense $_____
Utilities(Electricity, water, garbage, Gas) $ _____
Telephone $ _____
Other household Expenses $ _____

Food/Clothing/Transportation = _____%
Food (groceries) $ _____
Clothing, laundry, Dry cleaning $ _____
Auto loan payments $ _____
Other transportation $ _____
(parking, tolls, public transportation)

Other fixed expenses = _____ %
Medical, dental, optical care, prescriptions $ _____
Life Insurance $ _____
Other Insurance $ _____
Education $ _____
Charge account payment $_____
Personal care $ _____
(non-prescription drugs)
Other fixed expenses $ _____

TOTAL FIXED EXPENSES
$_____

FLEXIBLE EXPENSES

Pager $ _____
Cell phone $ _____
Entertainment $ _____
(movies, dining out, …)
Recreation $ _____
(vacation, hobbies)
Charitable contributions $ _____
Gifts $ _____
Home Improvement $ _____
Books, newspapers $ _____
Dues, allowance or misc. spending $ _____

TOTAL FLEXIBLE SPENDING
_____ % $ _____

Savings and Investments

Savings $ _____
Investments $ _____

TOTAL SAVINGS &INVESTMENTS
_____% $ _____

……SUMMARY……..

TOTAL FIXED EXPENSES $ _____
TOTAL FLEXIBLE EXPENSES $ _____
TOTAL SAVINGS & INVESTMENTS $ _____

TOTAL EXPENSES $ _____

Appendix 5

Balance a Checkbook Worksheet

Name _____

Balancing a Checkbook

Check registers help you keep track of your bank balance. *Subtract* each *check* from the previous balance and put the result in the last column. *Add* each *deposit* to the previous balance.

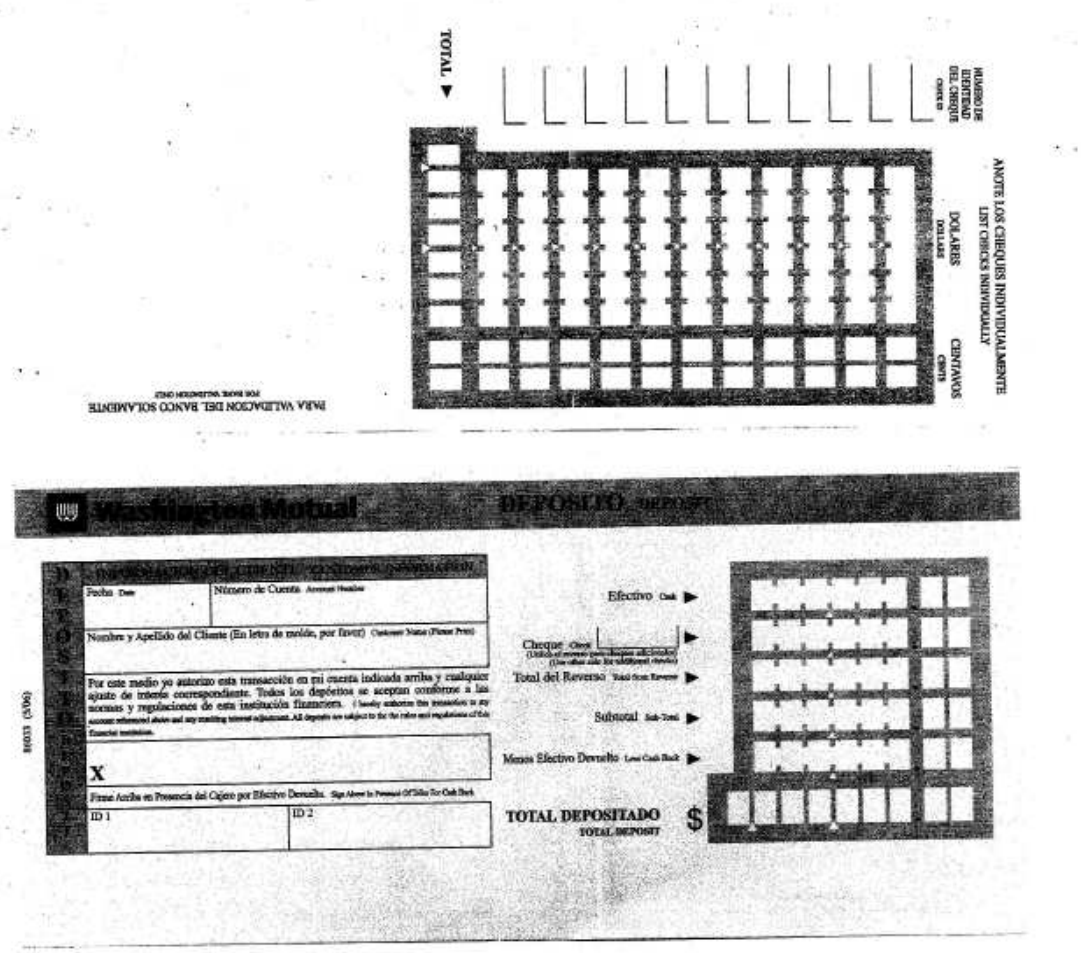
Find the amount of money Travis has left in his checking account on April 30th.

CHECK NUMBER	**DATE**	**DESCRIPTION OF TRANSACTION**	**PAYMENT/ DEBIT**	**DEPOSIT/CREDIT**	**BALANCE $ 1231.07**
201	4/1	Publix Grocery	103.82		
202	4/4	Jiffy Lube	111.26		
203	4/7	Red Lobster	72.25		
204	4/8	Bell South	201.44		
	4/9	deposit		473.53	
205	4/10	Geico Insurance	386.89		
206	4/11	NUI Gas Co.	75.53		
207	4/11	FP&L Electric Co	195.40		
208	4/12	A-1 Mortgage	521.57		
	4/12	deposit		713.98	
209	4/19	Car Loan	92.75		
210	4/21	Burdines	118.65		
211	4/21	Dry-Clean USA	5.00		
	4/21	deposit		428.60	
212	4/23	Carl's Furniture	219.74		
213	4/23	City of Perrine	123.90		
214	4/24	DSW Footwear	78.65		
	4/24	deposit		628.35	
215	4/25	Co. Prime Foods	77.78		
216	4/25	Sunny's Barber Shop	35.40		
217	4/28	Nick's Garage	187.65		
218	4/28	American Airlines	213.14		
219	4/30	Petco	97.80		

Remember to show all work.

Appendix 6

Deposit Slip


TOTAL
NÚMERO DE IDENTIFICACIÓN DEL CHEQUE
ANOTE LOS CHEQUES INDIVIDUALMENTE
LIST CHECKS INDIVIDUALLY
DOLARES
DOLLARS
CENTAVOS
CENTS
PARA VALIDACION DEL BANCO SOLAMENTE
Washington Mutual
DEPOSITO
Fecha
Número de Cuenta
Nombre y Apellido del Cliente (En letra de molde, por favor)
Por este medio yo autorizo esta transacción en mi cuenta indicada arriba y cualquier ajuste de interés correspondiente. Todos los depósitos se aceptan conforme a las normas y regulaciones de esta institución financiera.
X
Firme Arriba en Presencia del Cajero por Efectivo Devuelto
ID 1
ID 2
Efectivo
Cheque
Total del Reverso
Subtotal
Menos Efectivo Devuelto
TOTAL DEPOSITADO
$

Appendix 7

Volume of a Cylinder Task Sheet

Volume of a Cylinder
Task Sheet

Student Responsibilities:

1. **You** are responsible for recording all written information.

2. **You** are responsible for making sure the group stays on task.

3. **You** are responsible for overseeing the making of the "short" cylinder.

4. **You** are responsible for overseeing the making of the "tall" cylinder.

1 – 4 **You <u>all</u>** are expected to stay on task and contribute to the group's effort. Groups that stay on task and work to completion will receive a grade of '**A**'. You will also be graded on your written work and the completeness of it.

Remember to show <u>all</u> of your work!

Appendix 8

Volume of a Cylinder Procedure Sheet

– Volume of a Cylinder –

Take two identical sheets of paper. Roll one sheet into a short cylinder and the other into a tall cylinder. Set them both on a flat surface. Does one hold more than the other?

Procedure:

- Begin by taking one sheet of paper and join the bottom of the page to the top of the page (*do not overlap the paper*).
- The edges should meet exactly without having any gaps or overlapping. Tape the cylinder.
- Label this “Short”.
- Take another sheet of paper with the same size as the first sheet.
- Join the two sides (*left and right*).
- Tape this cylinder without any gaps or overlapping.
- Label this “Tall”.

Stand both cylinders on your desk.

1. Do they look the same?
2. What do you notice about the two cylinders?
3. Do you think these cylinders hold the same amount or do you think that one hold more than the other?

Discuss this with your group and record each person’s prediction with their explanation for their choice.

- Place the taller cylinder inside the shorter one.
- Place them both inside of the container.
- Fill the taller one with the cereal or filler.
- Carefully lift the taller cylinder so that the filler material is in the shorter cylinder.

1. Which cylinder holds more?
2. How did you arrive at that conclusion?
3. Was your group's original prediction correct?

Explain this problem mathematically?

Compute the volume of each cylinder. Remember to show *all* work!

- Volume of "short" cylinder _____
- Volume of "tall" cylinder _____

Things to think about:

- What items come packaged in cylindrical containers?
- What types of goods are packaged in boxes instead of cylinders? Why do you think companies use boxes?
- If a number is greater than 1, squaring it makes the result greater.

Did you know that?

- Designing cans and labels is just one aspect of packing technology. You see the results of this work every time you unwrap a CD, open a soda can, twist open a can of deodorant.
- Several universities offer degrees in packaging technology.
- Isopermetric figures are figures with the same perimeter.

Appendix 9

Volume of a Cylinder Response Sheet

Volume of a Cylinder
Response Sheet

Group Members:

1) _____
2) _____
3) _____
4) _____

Do they look the same?

1) ____ 2) _____ 3) _____ 4) _____

What do notice about the two cylinders?
Do you think these cylinders hold the same amount or do you think that one holds more than the other?

1) _____
2) _____
3) _____
4) _____

---- *complete the activity* --------

Which cylinder holds more?
How do you know?
Was your group's prediction correct?

Explain the problem mathematically.

Compute the volume of each cylinder. Remember to show *all* work!

- Volume of "short" cylinder
  _____
- Volume of "tall" cylinder
  _____

Work……*short*……

Work…….*tall*…….