Spring 2008

A Program Evaluation of Supplemental Instruction for Developmental Mathematics at a Community College in Virginia

Marilyn Lawson Peacock
Old Dominion University

A PROGRAM EVALUATION OF SUPPLEMENTAL INSTRUCTION

FOR DEVELOPMENTAL MATHEMATICS

AT A COMMUNITY COLLEGE IN VIRGINIA

BY

Marilyn Lawson Peacock
B.S. May 1975, Madison College
M.S. August 1980, The College of William and Mary

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

COMMUNITY COLLEGE LEADERSHIP

OLD DOMINION UNIVERSITY
February, 2008

Approved By:

Mary H. Duggan (Director)

Judy B. McMillan (Member)

Steve Myran (Member)

ABSTRACT

A PROGRAM EVALUATION OF SUPPLEMENTAL INSTRUCTION FOR DEVELOPMENTAL MATHEMATICS AT A COMMUNITY COLLEGE IN VIRGINIA

Marilyn Lawson Peacock
Old Dominion University, 2008
Director: Dr. Molly Duggan

With the current emphasis on accountability and the importance of math skills in our present economy, the success of developmental mathematics students at community colleges is critical. How to improve the success of these developmental students has become the impetus for many educational initiatives. One educational innovation in tutoring, called supplemental instruction, has been successfully applied to high-risk courses which are defined to have a failure rate in excess of 30%. Mid-Atlantic Community College, in its Title III grant which seeks to improve the success of developmental students, selected supplemental instruction as its initiative. This program evaluation investigated the effects of supplemental instruction on the learning gains, persistence, course completion, metacognitive and study skills of the developmental math students at Mid-Atlantic Community College. Qualitative and quantitative methods were used in this research study. Of special interest is the application of the Motivated Strategies for Learning Questionnaire to measure the metacognitive and study skills of students who have completed a supplemental instruction assisted course.

The researcher confirmed that the application of SI to developmental math at the community college did positively impact students' learning gains, persistence, and course completion when comparing SI classes to non-SI classes. The MSLQ revealed a positive impact in the areas of help-seeking and organization for SI students. The researcher also found a much larger withdrawal rate during the semester among non-SI students. The program evaluation revealed some aspects of the SI program that were not fully implemented, for example, the training of SI Leaders and the professional development for the faculty.

Where some results were near significance, the researcher suggests that further investigations would be indicated. The course completion rates and college persistence need to be investigated in a study with a larger sample size. Also, the MSLQ should be given as a pre-test with the students given feedback on how to improve their metacognitive and study strategies. Additionally, the effect on student performance of scheduling of a mandatory SI session each week should be investigated.

While much of the research on SI has been performed at four year colleges and in non-developmental courses, this study confirmed that SI can make a difference in the lives of developmental students at the community college level. The leadership of the community college is interested in the success of their developmental students and their retention, as well as the impact that SI could have on many other high risk courses.

I dedicate this dissertation to my family. Husband (Munk), daughter (Sheila), and son(Sean), supported, pushed, were neglected, ate too much fast food, and maintained their faith that Dr. was possible. Mama and Daddy Lawson encouraged and always kept a positive attitude through four years of limited visits and phone calls.

One of the greatest gifts
That life can give to anyone
Is the very special love that families share...
As years go by,
It's good to know that there will always be
Certain people in our lives who care.
For there are countless things
That only families have in common
And memories that no one else can make...
And these precious ties that bind a family together
Are bonds that time and distance cannot break.
How fortunate we are
When we have relatives to love us,
It makes the world a happy place to be...
Few gifts in life
Will last as long
Or touch the heart as deeply
As the very special gift
Of family.
--Craig S. Tunks

ACKNOWLEDGMENTS

I wish to acknowledge the Delta Kappa Gamma Society International for its assistance in the form of an international scholarship for $5,000 and an Iota state scholarship for $3,500. This organization's generosity was invaluable in assisting me to attain this doctoral degree. Besides their monetary support, the support and encouragement of many members has kept me going through tough times.

I also wish to acknowledge the encouragement and support of the members of cohort 2 of the Community College Leadership program. We have supported each other, laughed together, obsessed together, and learned how to step up to many challenges. They took turns "pushing me around" in the summer of 2005, and I could not have gotten here without them. Thanks to Al, Colin, Elizabeth, KW, Linnie, Matt, Patricia, Sonya, Troy and Wendy. Most of all, thanks to Mary for without her the program itself would have died and our dreams with it.

The advice and support of others who have passed this way before has paved the way for me. Dr. Molly Duggan was patient and wise in her advice and assistance as dissertation chair. Dr. Steve Myran was invaluable in his statistical advice, and Dr. Judy McMillan asked stimulating questions and kept me on track. Even though he was not on the dissertation committee, Dr. Dennis Gregory was the creator of the CCL program and recruited all the cohort 1 and 2 students. Thanks to his persistence and instruction, new PhD recipients are manning important leadership positions in colleges in Virginia and beyond.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Community colleges, a uniquely American innovation in higher education, have a commitment to open access for all students who can benefit from their programs. This commitment to open access brings many students to the community college with mathematics skills that are insufficient for student success in college transfer mathematics courses. These community college students take a placement test that reveals any deficiencies in their mathematics skills. Developmental students are those who test below college readiness and are required to enroll in developmental mathematics. Casazza and Silverman (1996) state that the word *developmental* implies a comprehensiveness that is not just about the remedial learning of subject matter but includes the notion of a complete support system that meets students at their current level and helps them to move forward in academic maturity. All of the community colleges in the United States offer developmental courses (Cohen & Brawer, 2003), and 41% of first-time students must take at least one developmental course (Weissman, Bulakowski, & Jumisko, 1997).

While enrolling in developmental classes is the first step in the remediation process, students must be successful in those courses in order to persist in their college careers. Research shows that developmental math students have pass rates of approximately 50% (Waycaster, 2001). Boylan (1997) found that the one-year retention rate for students who pass a single developmental class is 66.4% but only 9.6% for students who do not pass a developmental class. Other researchers (Castator & Tollefson, 1996; Waycaster, 2001) found that having poor mathematics skills negatively affected a student's grades in other college courses but completing remedial courses removed this relationship. Math skills for college readiness have even been found to be comparable to skills for work when researchers compared ACT test results with results from WorkKeys, an assessment that measures employability skills (Olson, 2006). Since these underprepared students are coming to the community colleges, and their retention in college rests on their success in developmental classes, then colleges must use innovative methods to help them succeed.

Background

In 1984 Olstad and Beal noted the decreasing number of mathematics and science graduates while the demand for mathematics and science teachers was increasing. Today, businesses are becoming concerned to the point where they are offering monetary incentives to encourage students to major in mathematics or science. In 2005 the General Electric Foundation donated $100 million to five school districts around the country with the hope of increasing the number of graduates going on to college (Borja, 2005). Their concern was based on projections by the U.S. Department of Labor showing that the United States will see a 51% rise from 1998 through 2008 in jobs related to science, engineering and technology without the skilled employees to meet that need (Borja). The Business Roundtable, an association of corporate chief executives, issued a statement that called for the United Stated to double its college graduates in math, science, and technology because the decline in these majors is causing America to fall behind in the world (Walters, 2005).

At the same time that the United States should be increasing its numbers of math and science majors, students are arriving at college with deficient mathematics skills.

Some states have mandated that universities not offer remedial courses, while other states have placed limits on the number of remedial courses a university can offer and require the universities to send their remedial students to the community college. The National Center for Educational Statistics [NCES] (1996) calculated the average percentage of students who successfully complete developmental courses in a national random sample (in Boylan, 1997). The NCES found that 74% of public two-year college students passed their developmental mathematics course within one year. This statistic, of course, includes students who passed the developmental math course in the first semester and also those who failed in the first semester but passed on the second try in the second semester.

The Institute for Higher Education Policy issued the report *College Remediation: What it is. What it costs* in 1998. They found that less than 1% of the nation's higher education budget goes to remediation, and this amount is a good investment for society and colleges (Waycaster, 2001). Students who are admitted to college, complete remediation, and enroll in regular courses provide a long-term social and economic benefit. Not only do these remedial students support the college with revenues, but these students go on to graduate, increase the Gross National Product, and increase the quality of life for themselves and others. The Institute also found, however, that remedial programs were not being assessed and evaluated. Without this assessment, colleges cannot improve their remedial courses in order to provide the best experiences for their students. In Virginia, in a longitudinal study of community colleges in the Virginia Community College System (VCCS), Waycaster (2001) found that the Algebra I developmental courses had a 43% pass rate and the Algebra II developmental had a 51%

pass rate. This data was collected from five randomly selected community colleges and represented an aggregate of results from 1993-2000. These low pass rates point to the need for an improvement in the learning that takes place in these remedial courses.

Learning assistance for remedial students takes many forms in colleges and universities. General learning assistance centers are a place for any student who needs help in any course to come for tutoring, computer-assisted learning, assessment, advisement, and/or counseling. The students who frequent the learning assistance center may be self- or instructor-referred because they are having difficulty in their courses (Perin, 2004). Other learning assistance includes peer tutoring where a peer with excellent math skills is assigned to tutor a student who is in need of help (Xu, Hartman, Uribe, & Mencke, 2001). Also, study groups, walk-in tutoring in math labs, distance (email and phone) tutoring, and computer-aided instruction are other forms of learning assistance that are used when students are identified as needing help (Hendriksen, Yang, Love, & Hall, 2005). The characteristic that makes these forms of learning assistance less effective is that they are reactive rather than proactive. Students must be already having difficulty in their classes before most of these methods are utilized. The method that is proactive and can assist all students in their courses is supplemental instruction (SI).

Supplemental Instruction (SI) was formulated at the University of Missouri at Kansas City (UMKC) in the mid-1970s by Deanna Martin as a learning assistance program to use in high-risk courses. High-risk courses are defined as those which usually have a grade distribution where more than 30% of the students score D, F, or W. Courses of this type have a mismatch between the low level of study skills that the students have and the difficulty of the material in the course (Congos & Stout, 2001). The emphasis in SI is on the identification of the course as a high-risk course, instead of identifying the students as high-risk students (Blanc, DeBuhr, & Martin, 1983).

Martin and Arendale (1994) defined features of supplemental instruction that contribute to student success. The characteristics of this learning assistance service are as follows: (a) SI is proactive rather than reactive (SI begins from the first day of class), (b) SI is attached to specific courses, (c) SI leaders attend all class sessions, (d) SI is not a remedial program, (e) Outside-of-class sessions are designed to promote a high degree of student interaction and mutual support, and (f) SI provides a way for the course instructor to receive feedback from the students through the SI leader. These features separate SI from other learning assistance programs.

UMKC does not list developmental math, however, as a suggested course for SI because of its small class sizes. Wright, Wright, and Lamb (2002) began an SI program at their four-year college because of a 77% failure rate in developmental mathematics. While their experience was statistically extreme, most developmental mathematics courses do have a failure rate exceeding 30%, qualifying them as high-risk courses eligible for the SI program. These researchers found a modification to the SI model that worked well in mathematics classes. They kept lecturing to a minimum and set aside class time for individual and group work. They also found that the pass rate of those students in SI increased to 50%, students' attitudes toward the course and mathematics in general were better, and that training of the tutors was an essential element for success (Wright et al.).

Supplemental Instruction has been studied extensively since its inception in the mid-1970s. At UMKC, data showed that the students who participated in SI performed at a higher level than students who did not, and course grades were significantly higher for the SI sections (Martin & Arendale, 1994). Evaluators at many colleges and universities all confirm that SI has helped students to perform at higher levels (Blanc, DeBuhr, & Martin, 1983; Boylan, 1997; Commander, Stratton, Callahan, & Smith, 1996; Congos, 2002; Congos & Schoeps, 1993; Gattis, 2002; Kochenour et al., 1997; Ogden, Thompson, & Russell, 2003; Ramirez, 1997; Reittinger & Palmer, 1996; Visor, Johnson, & Cole, 1992; Wild & Ebbers, 2002; Wright et al., 2002). Deanna Martin, the originator of the SI model, has explained that when SI is applied to a high-risk course student performance increases, but removing the SI yields a return to poor performance (Burmeister, 1996).

However, not all researchers agree with Martin on the effectiveness of SI. Schwartz (1992) claimed that students who are already the most likely to get the highest grades are also the most likely to attend study sessions. McCarthy, Smuts, and Cosser (1997) agreed and stated that prior academic ability was more causal for success than supplemental instruction. Bowles and Jones (2003/2004b) raised the question of inherent motivation on the part of the SI session attendees being the cause of their success. None of these researchers were investigating SI in developmental mathematics.

Statement of the Problem

Mid-Atlantic Community College is a large urban, non-residential, comprehensive community college serving 36,000 students (headcount) in the cities of Northland, Portville, Beachside, and Chelsea in Virginia. More than 70% of all entering students need developmental education before beginning college-level work (TCC, 2000). Of those students who enrolled in developmental classes, approximately 51% passed their courses (TCC). An additional concern is retention in that approximately 32% of the students who failed their developmental math persisted at MACC (TCC). Mid-Atlantic Community College's developmental education programs already use small class sizes, tutoring, and special labs to help students in these courses become ready for college-level coursework. Stern (2001) found that developmental education, with its emphasis on teaching basic skills, also needed to help students become better learners. The college wanted to incorporate a learning assistance method that would improve students' performance as well as their metacognitive and study skills.

The problem of this research study is the low pass rate and problems with student retention among failing developmental math students at Mid-Atlantic Community College. MACC was looking for an innovative learning assistance method for their students in their Title III grant *Creating the Conditions for Successful Student Achievement: Improving and Linking Developmental Programs and Student Services.* The MACC Task Force researched learning theory in order to look for ways to improve metacognitive and study skills and found that the cognitive theory of learning fit developmental students' needs well. The cognitive theory of learning has four assumptions: (a) Learning is an active process rather than a passive one, (b) Individuals have to think about a problem and reduce ambiguity before they can reach a solution, (c) Motivational drive is intrinsic, and (d) Before a learner can solve a problem, he/she needs to be able to look at the pieces of information that define the problem in different ways (Casazza & Silverman, 1996). This cognitive approach recognizes that the learner is the key component in the classroom, not the instructor. In discussing the teaching/learning process, Casazza and Silverman stated that an effective process increases awareness of one's own thought processes and encourages the learner to gradually assume the responsibility for learning. In order for students to reach this level of metacognition and increase performance and persistence, MACC selected the learning assistance method of supplemental instruction (SI).

MACC selected the SI method in an effort to improve their developmental mathematics courses, and this method needs to be evaluated to research its effectiveness. The Institute for Higher Education Policy is concerned that evaluation of remedial programs is minimal (Waycaster, 2001). Few colleges that have used SI have done so in developmental mathematics, and so there is a lack of research on the application of SI to developmental math.

This research study used Patton's (1997) framework of the utilization-focused evaluation to perform a program evaluation on the developmental mathematics portion of the Title III grant and specifically investigated how supplemental instruction was incorporated into MACC's developmental mathematics. Two sub-problems related to the developmental mathematics students themselves. First, the researcher compared the course completion and persistence rates for SI vs. non-SI students. Second, the researcher investigated whether students in SI recognized a higher level of metacognitive and study skills.

Purpose of the Study

The purpose of this study was threefold: (a) to investigate how supplemental instruction was implemented at Mid-Atlantic Community College, (b) to compare SI and non-SI students' completion and persistence rates in developmental math, and (c) to investigate developmental math students' metacognitive and study skills.

This study included two steps. The first step was to design and/or select the evaluation instruments which (a) assessed the performance of the developmental mathematics students, (b) evaluated the application of the SI model to MACC, and (c) assessed students'metacognitive and study skills. The second step was to conduct empirical research to examine the impacts of SI on the performance and persistence of the developmental mathematics students.

This evaluation was designed using Patton's (1997) framework of a utilization-focused evaluation. Patton specifies three levels of outcome goals in a program evaluation. The first level explores whether the program was implemented as designed. The second level investigates the success of the program. The third and highest level seeks to find long-term impacts of the program. All of these qualities of program evaluation were important to Mid-Atlantic Community College because MACC wanted to make sure the SI program was implemented correctly, its students were achieving success and persistence, and its students had metacognitive and study skills that would serve them well in future courses.

Significance of the Study

This program evaluation refined, revised, and extended the knowledge of the application of supplemental instruction to the developmental mathematics classroom. Patton (1997) advised that evaluation can be used to find out what programs are effective and therefore worth funding. Previously, very little research addressed the use of SI in developmental courses at the community college level. For example, one study explored the use of SI in developmental math courses at the university level (Wright et al., 2002). The originators of the SI model, the University of Missouri at Kansas City, recommend SI for high-risk classes that have a large enrollment. While the non-completion rate of developmental mathematics qualified these classes as high-risk, small class sizes are usually the rule for developmental courses. This quality of small class size could interfere with the effective implementation of SI because there may not be enough students in the SI sessions to produce the collaborative learning that is of great benefit.

This study sought to evaluate the effectiveness of the SI program at Mid-Atlantic Community College. Having the SI leader in the classroom who then follows the students into learning assistance sessions was a different model from what colleges often utilize for tutoring. Students in non-SI classes who may or may not avail themselves of the old tutoring model were compared to the SI students in the areas of course completion and persistence. If SI students showed a significant improvement in their course completion and persistence rates, then MACC would continue and expand the application of the SI method.

The community college and its students could be greatly impacted by this study. If developmental math students achieved success at greater levels with SI, then those students would be retained at the college. These former developmental students would become college transfer level students who would increase the number of students at the college and thus the funding base. Also, the success of SI in developmental math could cause the SI program to be extended into other disciplines, yielding greater success for students in high risk courses throughout the college. As increasing numbers of students progress and achieve in their programs of study, then the community college would successfully meet its mission.

Relationship to Community College Leadership

Community college leaders are focused on the success and retention of their students. While community colleges have always had this ideal, the demands of accrediting and governing agencies have brought this ideal into focus (Cohen & Brawer, 2003). Community colleges in the Virginia Community College System have been tasked with improving their retention and graduation rates (VCCS, 2003) in the *Dateline 2009* document. Therefore, VCCS colleges are evaluating programs for their effectiveness with the results being used to improve or dissolve these programs. Supplemental Instruction was selected by MACC because of its reputation as a tool to improve student success and retention. An increase in student success and retention could translate into an increase in enrollment and thereby an increase in funding for the college. In fact, research shows that the revenue gained by retention of students far outweighs the cost of the program itself (Burmeister, 1996; Commander et al., 1996; Congos & Schoeps, 1998; Wild & Ebbers, 2002). In addition, while MACC has applied the method of supplemental instruction only to developmental mathematics, many other adopters of this method have successfully applied it to all levels of high-risk courses (Blanc, DeBuhr, & Martin, 1983; Congos & Schoeps, 1993; Gattis, 2002; Hensen & Shelley, 2003). If MACC applied SI to its other high-risk courses, then it may see a gain and thus allow the college to better achieve its mission of educational access. This program evaluation gave the leaders at MACC important data to help them make an informed decision about the future of this program.

Definition of Terms

As this study focused on student performance and retention in developmental mathematics courses, several terms need to be defined:

1. Academic success – A student completing an attempted developmental mathematics course with a grade of Satisfactory (S).
2. Academic failure – A student who withdraws (W), receives a reenroll (R), or receives a grade of unsatisfactory (U).
3. Course completion – A student who completes a course with a grade of satisfactory (S).
4. Developmental mathematics – Courses in mathematics for college students who are lacking those skills necessary to perform at the level of college-transfer mathematics courses. The particular course examined in this study was Algebra I (Math 3).
5. Learning gains – The difference in score between a student's pre- and post-test score.
6. Student success – A final numerical grade of 75% or higher.
7. Metacognition – Skills those learners acquire which demonstrate an awareness of their own knowledge and their ability to understand, control, and manipulate their own cognitive processes as assessed by the Motivated Strategies for Learning Questionnaire (MSLQ). These skills include rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation (Pintrich, Smith, Garcia & McKeachie, 1991).

8. Rehearsal – The metacognitive strategy of reciting or naming items from a list in order to activate these items in working memory as assessed by the MSLQ (Pintrich et al., 1991).
9. Elaboration – The metacognitive strategy of building internal connections between items to be learned which stores information into long-term memory as assessed by the MSLQ (Pintrich et al., 1991).
10. Organization – The metacognitive strategy where the learner selects appropriate information and constructs connections among the information to be learned as assessed by the MSLQ (Pintrich et al., 1991).
11. Critical thinking – The metacognitive strategy where a student will apply previous knowledge to a new situation in order to solve problems as assessed by the MSLQ (Pintrich et al., 1991).
12. Metacognitive self-regulation – The metacognitive strategies of planning, monitoring, and regulating a student's own cognitive activities as assessed by the MSLQ (Pintrich et al., 1991).
13. Non-SI developmental math students – Students enrolled in developmental math sections that do not have an SI leader assigned to them.
14. Retention (persistence) – For the purposes of this study, retention was defined as the student reenrolling at the college in the subsequent semester.
15. Study skills – Skills that learners acquire involving time and study environment, effort regulation, peer learning, and help-seeking as assessed by the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991).

16. Time and study environment – The study skill of scheduling, planning, and managing one's own study time and setting aside an environment that is organized, quiet, and free of distractions as assessed by the MSLQ (Pintrich et al., 1991).
17. Effort regulation – The study skill of control of a student's own effort and attention in the face of distraction which includes a commitment to one's own study goals as measured by the MSLQ (Pintrich et al., 1991).
18. Peer learning – The study skill of collaborating with one's peers in order to clarify course material and reach insights as assessed by the MSLQ (Pintrich et al., 1991).
19. Help-seeking – The study skill of recognizing one's own ignorance, identifying someone who can offer assistance, and seeking that assistance as assessed by the MSLQ (Pintrich et al., 1991).
20. Supplemental Instruction – The learning assistance program that originated at the University of Missouri at Kansas City which uses a supplemental instruction leader who attends class, serves a model student, and holds supplemental sessions outside the classroom.
21. Supplemental Instruction Leader – The student who is selected for his/her academic knowledge and communication skills to provide learning assistance for the supplemental instruction classes.
22. SI developmental math students – Students enrolled in the developmental math classes who have a SI leader assigned to them.

23. Time log – The itemized document that an SI leader keeps on a biweekly basis that enumerates time spent in the classroom, in sessions, in planning, and in training.

Research Questions

Although some researchers have contrasted program evaluation with research stating that program evaluation is about action and where research is about knowledge and truth (Cronbach & Suppes, 1969), program evaluation can produce the same results that research produces. In fact, program evaluation in an academic setting is often used for research purposes (Patton, 1997). Evaluation of programs that impact student success, retention, and/or performance are approached using research models (Congos & Schoeps, 1999; Blanc, DeBuhr, & Martin, 1983; Boylan & Saxon, 1999). Academic environments need evaluation results that are based on sound research principles and are generalizable, thereby making the evaluator a social science researcher. These research purposes work together with the utilization-focus of the evaluation to produce results that can serve to increase the knowledge base in the field (Patton, 1997).

This study, therefore, used Patton's (1997) utilization-focused evaluation model as a framework for a program evaluation on the SI program at Mid-Atlantic Community College. Patton specifies three levels of outcome goals: (a) implementation-level, (b) mid-level, and (c) ultimate-level. Implementation-level goals are set to determine if the program being evaluated is operating as planned. Mid-level goals are associated with determining what successes the program is having. Ultimate-level goals refer to long-term outcomes of the program. Accomplishment of the first level of goals makes success in the next levels possible. The research questions guided this program evaluation by examining these three levels of goals.

First, MACC used the University of Missouri at Kansas City guidelines to form the SI program as described in the Title III grant (TCC, 2000). Therefore, for the implementation-level goal, the implementation of the requirements for the SI leaders, their training, and SI sessions were evaluated at MACC to determine how well the current program follows the guidelines set forth in the Title III grant. The research question for this implementation-level goal was as follows:

1) Has the supplemental instruction program been implemented at MACC in accordance with the Title III grant?

Second, many colleges and universities reported improvements in student success and persistence when SI was used (Blanc, DeBuhr, & Martin, 1983; Boylan, 1997; Wright et al., 2002), but some authors claimed that these improvements were due to the nature of the students who attended supplemental instruction (Schwartz, 1992; McCarthy, Smuts, & Cosser, 1997; Bowles & Jones, 2003/2004a). To evaluate the mid-level goal this program evaluation sought information on success and persistence rates of the students in the developmental mathematics program at MACC. As MACC moved from its Title III funding of SI to institutional funding, the community college had to know if that model was providing learning assistance for MACC students. The research question investigating this mid-level goal was

2) What was the impact of SI on the course completion rates, persistence rates, and learning gains for SI developmental mathematics students as compared to those for non-SI developmental math students?

Finally, the ultimate goal for developmental students is that they have metacognitive and study skills that will enable them to be successful in their college transfer classes (TCC, 2000). The supplemental instruction program was designed to increase a student's metacognitive and study skills by making him/her an independent learner (TCC). The ultimate-level goal was that a student gains these skills, and the research question to guide the investigation was

3) What metacognitive and study skills do supplemental instruction students in developmental math have that will assist them in being successful in their future courses as compared to non-SI developmental math students?

Overview of Methodology

This mixed method study used a quasi-experimental design which utilized intact SI and non-SI developmental mathematics classes, randomly selected from course offerings on all four campuses of Mid-Atlantic Community College. The researcher insured that all campuses and populations of MACC were represented in this sample of courses. At the beginning of the semester the students in these randomly selected courses completed a pre-test of the mathematics skills that were deemed necessary for successful completion of the course. This pre-test also contained a section asking for each student's demographic information (age, race, sex, full-time vs. part-time enrollment, and work status). A coding system identified the students by number only to maintain student confidentiality. These pre-test scores were used to compare SI and non-SI sections to insure that classes were not substantially different in their mathematics knowledge at the beginning of the semester. Students also completed an equivalent post-test at the end of the semester. The comparison of these pre- and post-test results provided a measure of the learning gains in the students' mathematical knowledge in the SI and non-SI sections. Final numerical grades for all students were also used to compare the final grades of the SI and non-SI sections.

Students were surveyed at the end of the semester to gain information about their metacognitive and study skills. The survey instrument was the Motivated Strategies for Learning Questionnaire developed by Pintrich et al. (1991) at the University of Michigan which had been verified to be valid and reliable. Questions focused on the metacognitive strategies inquired about the student's ability to understand, control, and manipulate their own cognitive processes. Study skills questions inquired about a student's self-regulation, time and effort management, help-seeking, efficacy and control beliefs (Pintrich et al., 1991).

Additionally, students from the SI courses were involved in focus groups near the end of the semester. These focus groups sought qualitative feedback on the SI program and were conducted on all four campuses of MACC. Students were randomly selected and invited to participate in these focus groups. Each faculty member involved in SI, per campus, were interviewed. This qualitative information was used to check for program consistency between the SI model from the University of Missouri at Kansas City as described in the Title III grant and the model implemented at Mid-Atlantic Community College.

After the conclusion of the semester, the MACC Student Information System was used to collect the student grade and re-enrollment information for each student in the randomly selected courses. A grade of S indicated student success, and grades of W, R, or U indicated student failure. Re-enrollment was defined by a student's enrollment at

MACC in the subsequent semester at a time past the add-drop period. Using each student's numerical code to maintain the database containing pre-test, post-test, grade, numerical grade, and re-enrollment information maintained confidentiality. The statistics gained from this information were reported as group data.

A documents review was also used to evaluate the supplemental instruction program. The Title III grant itself was examined for purposes, objectives, and details of the SI implementation. SI leader time logs were analyzed for times spent in each of the SI activities. The MACC website for SI was reviewed to gain an overview of the philosophy of the SI program as implemented at MACC.

Limitations and Delimitations

This study was performed at a multi-campus community college which has both urban and suburban settings. The results may not be generalizable to other community colleges or other institutions of higher education because of this narrow focus. This threat to external validity was lessened, however, by the presentation of statistics on the demographics of the students and their pre-test scores. In this way other colleges would be able to compare their college population to the subjects in this study.

Another threat to external and internal validity was the self-selection of the subjects into the SI (treatment) or non-SI (control) classes. A comparison of the pre-test scores established whether or not the groups were equivalent at the beginning of the study in terms of prior algebra achievement. Performing this comparison lessened this threat to validity by confirming that the difference in level of algebra achievement at the end of the study between the groups was due to the independent variable of supplemental instruction.

The instruments used in the study were classroom tested before the data were collected to insure reliability and validity. The pre-test was given to successful developmental algebra classes students, and faculty were invited to comment. Student results established the validity of the test, and faculty comments established the reliability of the test.

As Waycaster (2001) reported, attrition is a threat to internal validity in developmental mathematics courses. Also, differential attrition may be a problem if one group has a significantly higher withdrawal rate than the other group. Given that persistence was a dependent variable in the study, the researcher was looking for differences in persistence in the two groups, but the study was not using retention in the semester as a dependent variable. In terms of the achievement variable, if differential attrition occurred, then comparative members of the other group could be eliminated in the statistical analysis of the study.

Diffusion of treatment could be a threat to internal validity because members of the non-SI (control group) could voluntarily attend SI sessions as often (or more) than students in the SI (treatment) group. While it is unlikely that all the members of the control group would elect to attend as much as the treatment group, it was a possibility. Students from both groups who attend SI sessions were identified by the SI leader taking roll at each of the SI sessions, and this identification became part of the database in the study.

Treatment fidelity was also a possible threat to the internal validity of this study. Instructors implemented SI in their individual classrooms using their own individual opinions of how this implementation might best take place. Similarly, the SI leaders took on different roles in the classroom according to which instructor they were assigned. These same SI leaders might also have conducted their sessions in different ways according to the needs of the particular students who attend the session.

The program evaluation did not study the effects of the full range impact of the Title III grant. This grant implemented student development programs and provided the MACC website for learning assistance. These facets are beyond the scope of this evaluation. Additionally, the Title III grant included developmental English as well as developmental mathematics which would have been too large a group to adequately examine in this study. For these reasons, the scope of this program evaluation was narrowed to the developmental mathematics usage of supplemental instruction at Mid-Atlantic Community College.

Conclusion

The ability of the United States to retain its standing in the world economy rests on its ability to keep up with the pace of technological advancements. This ability depends on the supply of math, science, engineering, and technology graduates from higher education. However, the United States is falling behind in the supply of these graduates, and fewer and fewer students are choosing to major in these fields. In order to increase the supply of graduates in these scientific fields, the United States must do a better job of bridging the gap between the skills with which a student enters college and the skills necessary to be successful in science and math careers. Supplemental instruction, as developed by the University of Missouri at Kansas City, has been shown to improve students' performance, retention, and metacognitive skills in high-risk courses.

With a pass rate at 50% in their developmental courses, Mid-Atlantic Community College applied for a Title III grant to improve performance in developmental studies. Upon award of the grant, MACC adopted the supplemental instruction learning assistance program in an effort to improve its developmental students' success rate. Now at the end of the five year grant period, this program evaluation examined the results of the supplemental instruction implementation in developmental mathematics. During this evaluation the researcher gathered information on faithfulness to the MACC grant, course completion rates, persistence rates, final grades, and student levels of metacognitive and study skills. As MACC pondered how and/or whether to continue supplemental instruction, this program evaluation provided valuable information that could be used to make decisions about the future of SI at MACC.

CHAPTER II

REVIEW OF THE LITERATURE

Chapter II provides a comprehensive review of the literature related to this study. This review is presented in twelve sections that explore the current literature. Section 1 examines community college students, their demographics, and their challenges in college. Section 2 addresses the need for math skills in today's world, while section 3 explores the lack of those math skills in students at the community college level. Section 4 examines the current research on help-seeking behavior among college students, and section 5 profiles the types of learning assistance available to students who seek help. Section 6 focuses on the components of the supplemental instruction system, while section 7 examines SI in more detail. Section 8 enumerates the desired outcomes of SI, and section 9 examines the possibility of mandatory attendance at SI sessions. Section 10 labels the stages of frameworks in program evaluation, and section 11 examines Patton's utilization-focused evaluation method. Section 12 summarizes the literature on the topic of supplemental instruction and the program evaluation of such a model.

Community College Students

Community college students attend college for very practical reasons. In 1986, the Center for the Study of Community Colleges found that 36% of community college students intended to transfer to a four year college, 34% sought job entry skills, 16% sought job upgrading skills, and 15% enrolled for personal interest. More recently, Voorhees and Zhou (2000) found that these figures had not changed very much with 66% seeking a certificate, terminal degree, or transfer degree, 21% enrolled to improve job skills, and 12% enrolled for personal interest (in Cohen & Brawer, 2003). The American

Association of Community Colleges [AACC] also found that students want classes that are nearby with convenient class schedules, and the students want these classes for self-improvement (Shults, 2001). Earning a degree or certificate will have its own reward because students with associate degrees and certificates are more likely to have higher status and higher paying jobs. In fact, a student with an associate's degree will have an average lifetime earning of $250,000 more than people without degrees (Shults). Increasingly, however, these same students are subject to many pressures that may make their accomplishment of a degree difficult.

Challenges to Persistence

Student characteristics. Age is the first student characteristic that may be a barrier for community college students. Undergraduate students are older than they have been in times past. By 1993 slightly more than 40% of all undergraduates were 25 or older and almost 27% were 30 or older (Pascarella & Terenzini, 1998). The most recent Community College Survey of Student Engagement [CCSSE] determined that 37% of their respondents were over age 24 (2005). While older students are often more goal-oriented, some research has indicated that age can be a predictor of attrition by itself (Greer, 1980; Lanni, 1997). In fact, several studies have found that older students are more likely to drop out of college than are younger students (Brooks-Leonard, 1991; Windham, 1995). Several reasons for dropping out of school may be that these older students have home responsibilities that may also affect their persistence at the community college (Bers & Smith, 1991), and 37% of community college students spend 11 or more hours per week caring for dependents (CCSSE, 2005).

Working and attending school part-time or full-time is another characteristic of students which can be a challenge to persistence. In 1993, 46% of all college students aged 18-24 were employed (Pascarella & Terenzini). By 2001, the AACC found that 80% of community college students were working full or part-time (Schults). In fact, the CCSSE found that 57% of community college students work more than 20 hours per week (2005). Research has found that this demand of having to work while attending school can lead to dropping out of school or stopping out of school for one or more semesters (Lanni, 1997; Swager, Campbell, & Orlowski, 1995; CCSSE, 2005).

Economic demands. It is essential for the economic welfare of the United States that community college students be successful in overcoming these challenges. These students need skills to prepare them for the technologically-based jobs of today. Math skills that are needed on today's jobs include: (a) measurement, (b) numerical and quantitative skills, (c) statistical process controls, and (d) spatial and geometric skills (Bracey, 2001). However, as important as these skills are, the United States is falling behind in attainment of these skills. The Business Roundtable, an association of corporate chief executives, has published a report entitled *Tapping America's Potential: The Education for Innovation Initiative* which warns of America's decreasing leverage in science, technology, math, and engineering (Walters, 2005). This report also calls for the creation of undergraduate retention programs that will produce more math, science, and engineering majors.

Business leaders are so concerned about the lack of skills in today's marketplace that they are sponsoring activities in the secondary schools. The General Electric Foundation announced that it will donate $100 million over five years to raise math and science scores in five school districts around the U. S. and increase the number of high school graduates going to college (Borja, 2005). The first school district to be chosen for a grant from the GE Foundation was the Jefferson County, Kentucky school system. This system was selected because only 38% of their students scored as proficient in state math tests. The IBM Foundation is also concerned about projections by the U. S. Department of Labor that from 1998 to 2008 jobs related to science, engineering, and technology will increase by 51% (Borja). The IBM program entitled *Transition to Teaching* involves the retraining of IBM employees to become math or science teachers.

The skills that will evidence a person's preparation for work have been found to be the same skills needed for college readiness. ACT, Inc., the test-making company, compared the scores of more than 476,000 high school juniors on two of its tests: the ACT college-admissions test and WorkKeys which assesses employability skills in nine areas. Although employers have often said that they want high school graduates to have good skills, this study was the first to show that skills for college readiness related well to skills needed for work. Unfortunately, the ACT study also found that many high school graduates need remedial work whether they enter the workplace or a college (Olson, 2006).

Need for developmental education. Students often arrive at the community college in need of skills development in order for them to be successful in college. Shults (2001) found a wide variety of students who need developmental courses, from those who need refresher courses to those who need several levels of remedial work. Boylan and Saxon (1999) stated that the weakest students required the discipline of a structured course and immersion in the subject. They also recommended that students who were placement tested and found to be in need of developmental education should be required to take the developmental courses. Cross (1976) stated that fewer than 10% of those needing remediation are likely to be successful in college without it. Success in developmental courses has been consistently found to be a factor in college success and persistence (Boylan & Saxon). In order for students to be successful, Boylan recommended a highly structured learning experience because of developmental students' lack of organizational skills.

In an ex post facto study, Castator and Tollefson (1996) studied grades in 33 college-level courses. Students who were recommended to take developmental courses and did so earned higher grades in their college-level courses than students who did not take the remedial course before enrolling in college-level courses. These under prepared students' skills had a negative effect on all their course grades, and this negative effect was found to be significant in 100% of the courses studied. Another aspect affecting developmental students is their hesitance to seek help.

Help-seeking behavior. One would expect a direct linear relationship between the need for learning assistance and students' help-seeking behavior. However, Karabenick and Knapp (1988) found that students with the highest (and lowest) need for learning assistance sought help the least. In their study of 612 Introductory Psychology students, they found that help-seeking occurred with the highest frequency for those students in the B- to C+ range, while those students with D and lower grades exhibited almost no help-seeking behavior. In looking for reasons for this lack of help-seeking behavior, Karabenick and Knapp suggested that attribution theory might hold the answer. Attribution theory, as defined by Weimer, points to a cycle of a person attributing his/her lack of success to low ability and that attribution to low ability causes an expectation of future failure (Karabenick & Knapp). Accompanying this expectation of failure are feelings of guilt, embarrassment, hopelessness, and resignation which would also hinder help-seeking behavior.

This cycle of expectation of failure and then the self-fulfillment of that expectation has also been noted in developmental algebra classes. For example, in a study of 325 provisionally-admitted students at the University of Georgia, Thomas and Higbee (2000) found those students' attitudes toward the developmental algebra class and their expectations of their own performance in that class affected their attendance and performance. Students with poor attitudes toward the developmental algebra course had a high number of absences and poor grades on homework and tests. These students did not involve themselves in the activities of the class, and this lack of involvement combined with their poor attitudes contributed to their eventual failure (Thomas & Higbee).

Astin's Theory of Involvement supports the idea that the more students are involved in their own education, then the more they will learn, the more satisfied they will be with their education, and the more likely it will be that they achieve their educational goals (1996). Glover (1996) investigated the role of effort in determining students' success in developmental algebra (in Thomas & Higbee, 2000). Her research of 522 developmental algebra students asked students about making use of office hours of instructors, asking questions during and after class, taking notes, working with other students outside of class, studying examples in the text, doing homework, and seeking assistance. Glover found that each of these behaviors had a significant and direct effect on a students' course grade.

Summary and Critique

Research has defined why students attend community colleges (Cohen & Brawer, 2003), their characteristics and challenges (CCSSE, 2005), the need for their success (Bracey, 2001; Borja, 2005), their need for developmental education (Schults, 2001), and their hesitance to seek help (Karabenick & Knapp, 1988). However, research has not adequately defined how the community college can best serve these students with learning assistance to help them to overcome these deficits. More study needs to be made of the types of assistance the community college offers, and this assistance needs to be assessed for its effectiveness. There are a multitude of different models of learning assistance, and the community college needs to select the best model for its students that will optimize their success.

Learning Assistance Models

With the challenges to persistence that today's community college students face, their colleges need to provide learning assistance to intervene when students have difficulty. Colleges respond to this student need in a variety of ways which are customized to attempt to meet the needs of their students. Several of the models that attempt to offer learning assistance are general purpose tutoring labs, break-out sessions for large classes, peer tutoring, and supplemental instruction.

One of the primary learning assistance models is the general purpose learning assistance center that will assist both developmental and college transfer course students. The services in a general purpose learning assistance center of this type will include academic tutoring, computer-assisted learning, assessment, advisement, and counseling (Stern, 2001). Typically the services of such a center are free, and students are self-referred or referred by their instructors when they have difficulty (Perin, 2004; Grady & Carter, 2001). A difficulty with this type of learning assistance is that most of the services provided to these students are in a one-on-one fashion, ignoring the present recommendation for collaborative learning (Boylan, 2002). Another concern is that instead of being proactive, the reactive nature of this kind of assistance means that students are already in academic peril by the time their assistance begins. Students will only seek out this type of learning assistance after they have a failing grade.

A second type of learning assistance is the creation of break-out sections for large classes. This method is primarily used in universities where the class size ranges upwards from 400 students (Spencer, 1992). There is a professor for the mass lecture and graduate students for the sections which have about 30 students each. The large lecture sections were instituted to save money, but high failure rates forced the universities to form the break-out sections. Some universities have begun to require the break-out teachers to attend the mass lectures to insure that students are taught in the same way in both formats (Spencer).

A similar method of learning assistance is the use of peer tutors who are trained and certified. These peer tutors are trained to shift the responsibility for learning to the student (Xu et al., 2001; Barr & Tagg, 1998). By using collaborative learning and placing the responsibility for learning on the student, learning assistance aims to improve academic self-efficacy and college persistence. For example, the Freshman Year Student Study Center at the University of Arizona found that tutoring helped students at the lower math performance level more than students at the average or above average levels. However, the research on this program was unable to establish their claim of self-efficacy or persistence. In addition, this type of program is also reactive in nature as seen by their stated primary goal of assisting weaker students to improve (Xu et al.).

A specialized form of peer tutoring is the learning assistance model of Supplemental Instruction (SI). Deanna Martin at the University of Missouri at Kansas City had been tasked with improving their tutoring system and designing a more effective model in the mid-1970s. She designed a proactive model where the peer tutor would attend the class and then hold tutoring sessions outside of class time. In this way, she felt that the tutor could more effectively assist the students. In addition, Martin felt that training the tutors to use collaborative learning where the tutees would be challenged to find the answers in their own notes and/or work together to answer their own questions would be more effective than having the tutor try to reteach the material from the class (Burmeister, 1996).

Summary and Critique

The difficulty with general purpose learning assistance services (Stern, 2001), break-out sessions (Spencer, 1992), and peer tutoring (Xu et al., 2001) is that all these methods are focused on the student who is already failing or in danger of failing. This reactive focus places an added burden on the students who are seeking help because they must remediate on the topics they have failed while trying to learn new material as their class moves forward. A better alternative would be to have a proactive method of learning assistance that helps all students from the first day of the course. Although the research suggests that supplemental instruction is a better type of learning assistance, research on the topic of using SI in a developmental math course is limited. Furthermore, such research has not been attempted at the community college level.

Supplemental Instruction

As mentioned previously, supplemental instruction is a proactive model of learning assistance that was developed at the University of Missouri at Kansas City in the mid-1970s (Blanc, DeBuhr, & Martin, 1983). At that time freshman and sophomore failures (D and F grades and withdrawals) were averaging 40%, and Martin was tasked with developing a system of assistance. She developed a model for use in high-risk courses which were defined as those having a failure rate exceeding 30% of the course registrants. The services for the students would be attached directly to such a course. Student tutors, called supplemental instruction leaders [SI leaders], attend classes and act as model students during the class period. They take notes and complete assigned readings even though the SI leader has already successfully completed the course. During the first week the SI leader surveys the students about their availability for sessions outside of class and schedules 2-3 sessions per week. During these sessions the SI leader facilitates student interaction on course concepts and tries to increase study skills and reasoning. The SI leader's role is not designed to be that of a professor who re-lectures on the material. Collaborative learning within the session is intended to boost a student's self-confidence, self-reliance, and critical thinking skills. Questions raised in the session are referred to other students and are investigated in the notes.

Features of Supplemental Instruction

Supplemental Instruction was designed to be proactive rather than reactive because the high-risk course is identified before the term begins, and all students receive assistance from the first day of class. SI also lays no blame for deficiencies of the student's prior knowledge because SI takes the students from where they are and assists them to learn. Since the SI leader attends the course, he or she is aware of the instructor's preferences and can assist the students accordingly. The SI leader can even compare his or her notes to notes from the students to improve note-taking in the course. Such deficiencies may be found when students are working collaboratively in the SI sessions to find answers to questions (Blanc et al., 1983).

SI Sessions

Most student questions are detail-oriented and superficial which illustrates that students perceive their need for learning assistance to be content-centered. However, these students' actual need is for learning and thinking skills that are prerequisites to content-mastery. For this reason, the SI leaders will turn all questions generated back to the group for exploration and solution. The SI leader also integrates vocabulary development, mnemonics, and other techniques into the content review (Blanc et al., 1983). Congos and Schoeps (1993) noted that students view SI sessions as safe environments where they feel freer to take chances, reveal weaknesses, ask for help and accept advice. SI leaders also help students to design effective study schedules.

SI Leader

There are several qualities and traits that are sought when selecting an SI leader. He or she is a student who has successfully completed the targeted high-risk course with a grade of A or B (Congos & Stout, 2001; Rettinger & Palmer, 1996). Besides content knowledge, an SI leader must have good interpersonal and communication skills. The SI leader should also be willing to undergo training and be compatible with the SI model. Reittinger and Palmer called the SI leader the heart of the program. The SI leader also must be detail-oriented because he or she must design and take attendance at each SI session, and these attendance lists are used for research purposes only.

Attendance at SI Sessions

Attendance at SI sessions is purely voluntary. In fact, Deanna Martin, the original designer of SI, had recommended that no extra-credit or incentive measures be awarded for attendance at sessions. Reittinger and Palmer (1996) used an incentive of dropping the students' lowest quiz grade if they had attended 90% of the SI sessions. Wright et al. (2002) only had 18.8% of students participate in developmental math SI sessions, and they recommended that the SI leader pass out handouts during the sessions that students could receive only if they attended. Some schools have even added extra time during class for the SI session in order to encourage students to participate in the sessions (Ramirez, 1997; Hodges, Dochen, & Joy, 2001). Since supplemental instruction's major contribution to student learning is taking place in the sessions, the effectiveness of SI is hindered by these low numbers of students attending sessions.

Supplemental Instruction Model

In formulating the SI model, Martin was challenged to create more than a tutoring program. The four main goals that she set for the program were that it would (a) support cultural diversity, (b) support critical thinking, (c) increase retention and performance, and (d) be replicable and adaptable. First, to support cultural diversity, SI was designed to target high-risk courses rather than high-risk students. All students in the SI course are identified before the course begins as needing help, which makes it easier for students to seek help and not feel stigmatized. Second, Supplemental Instruction supports critical thinking because the SI Leader does not tell the students the answers to their questions.

The leader poses the questions to the session attendees who in turn find the answers collaboratively. Third, Supplemental Instruction was also designed to increase retention and performance by increasing a student's time-on-task. The more time a student spends on a topic both in class and in the SI session, the more he or she will understand that topic and perform. Students who are successful in their courses should then be retained at a higher level. Retention is also supported by the feeling of inclusion that a student has who attends the SI sessions and becomes involved in the group. Last, SI was formulated to be replicable and adaptable. The method is designated by UMKC, but colleges are also encouraged to adapt the method to best fit their needs (Blanc et al., 1983).

Desired Outcomes of Supplemental Instruction

Retention. The first outcome that SI seeks is improved retention, and retention is defined in different ways at different colleges. Wild and Ebbers (2002) found several different definitions of retention: (a) continuous enrollment throughout a semester, (b) program completion, (c) students meeting their own objectives, (d) continuous enrollment for two or more semesters, or (e) continuous enrollment for a second semester with completion of two-thirds of courses attempted with a 2.0 GPA or higher. Another issue related to community college retention is the theoretical models used for student retention. One model is from Tinto (1975) who identified the major factor in retention as academic and social integration into the college. The other theoretical model is from Astin (1977) who recommended interaction with peers and faculty in order to boost retention (in Wild & Ebbers). Regardless of the model used, Wild and Ebbers recommended that supplemental instruction be a part of the community college strategy for student retention.

Research shows that students who attend Supplemental Instruction sessions are more likely to re-enroll the following semester (Bowles & Jones, 2003/2004b; Blanc et al., 1983; Congos & Schoeps, 1998). In addition, Supplemental Instruction has been shown to dramatically increase retention for underprepared students who entered college on provisional admission (Ramirez, 1997; McCarthy, Smuts, & Cosser, 1997; Ogden, Thompson, & Russell, 2003). Using Astin's model, Ogden et al. (2003) stated that the small, interactive nature of SI sessions help the underprepared student to make a connection to the college and thus be more likely to be retained.

Achievement. The second outcome that SI seeks is improved achievement, and students who attend Supplemental Instruction sessions have higher final grades than students who do not. In introductory biology classes, Congos and Schoeps (1998) found that 86% of SI students received grades of A, B, or C as opposed to 65% of non-SI students who received A, B, or C. In an introductory economics course this rate of receiving grades of A, B, or C went from 66% to 82% while SI utilization went from 0 to 45% of the students (Blanc, DeBuhr, & Martin, 1983). Reittinger and Palmer (1996) found 51% of SI students made grades of A or B in psychology as opposed to 40% of the non-SI students.

In particular, for students who enter college with low academic achievement SI session attendance has been shown to have a greater impact on their course achievement than for traditional students. In South Africa in a Circuits course, McCarthy et al. (1997) found that while there was no significant difference in the average final grade of SI and non-SI students who entered the university under regular admission, but provisionally admitted students passed the course at rates of 54% for the SI session attendees and 41%

for the non-SI. The results of this McCarthy et al. study must be regarded with caution, however, because South Africa uses a substantially lower failing percentage than most colleges in the United States (49% and below). Ramirez (1997) found that on average specially admitted students who attended SI sessions had a significantly higher GPA: 2.45 course grade (on a 4.0 system), while non-SI students had a 1.48 course grade. Ogden et al. (2003) also found that SI attendees who were conditionally admitted students had a significantly higher GPA: 0.70 higher overall over a year span than the non-SI attendees. This long-term effect for specially admitted students was also shown to be significant by Ramirez (1997) where SI attendees had a cumulative GPA of 2.62 compared to non-SI attendees GPA of 2.45 over an eight semester period.

One concern of researchers is whether students who have higher pre-existing achievement and/or are more motivated are the ones attending the sessions, and thus would receive better grades anyway. By using prior academic achievement and motivation as covariates in statistical analyses, Congos and Schoeps (1999) showed that SI participants had significantly higher grades despite there being no original significant difference in the two groups of SI and non-SI participants. Bowles and Jones (2003/2004a) found that students with low academic ability were more likely to attend SI sessions and even under this consideration the SI attendees achieved a significant 0.50 grade points higher than the non-SI attendees on a 4.0 scale. Gattis (2002), in a Chemistry II course, also found that students who regularly attended SI made a half of a letter grade higher than the non-SI even when motivation was factored out using analysis of covariance. Therefore, removing the effect of motivation or prior academic achievement does not change the result that SI attendees have higher achievement than non-SI attendees.

Satisfaction. The third outcome that SI seeks is student satisfaction with the course. Students entering high-risk courses in their freshman and sophomore years of college are usually doing so because the class is a requirement. Students' attitudes about developmental courses are especially poor owing to the lack of college credit, the stigma attached to remediation, and prior poor achievement. Tinto (1987) pointed out that isolation and incongruence on the part of students can lead to a sense of being in conflict with the college. Wild and Ebbers (2002) and Stern (2001) recommended supplemental instruction in order to increase the sense of belonging and satisfaction with the college.

Interviews with students who have attended SI sessions consistently point to their satisfaction with the course. Congos and Stout (2001) conducted end-of-semester surveys in Biology, Psychology, Math, Physics, and Chemistry and collected the following comments from students who had attended SI sessions:

> SI broke solutions to problems down into steps which are easier for me to understand and remember. The study skills in SI helped me get higher grades in math than ever before—I understood it for the first time in my life. SI sorted out the professor's confusing lecture notes—SI explained difficult concepts not thoroughly covered in class. The practice tests in SI were the most helpful—They let me know if I really knew how to solve a problem before I took the test. I would have failed chemistry again if it wasn't for SI—I usually had a hard time grasping the information when the prof covered it in class but going over it again in SI helped me to understand. (p. 47-48).

Inclusion of supplemental instruction sessions for these students increased their satisfaction with these high-risk courses.

Congos (2003) uses Gibb's Theory of Helping Relationships to list conditions in the SI sessions that make students feel greater satisfaction with the course:

1. Reciprocal trust – promotes confidence, warmth, and acceptance.
2. Cooperative learning – promotes inquiry, exploration, and mutual assistance.
3. Mutual growth – promotes becoming, actualizing and fulfillment.
4. Reciprocal openness – promotes spontaneity in thought and speech.
5. Shared problem solving – promotes defining problems, generating alternatives,

   and testing alternatives in an open environment.
6. Autonomy – promotes freedom, interdependence, and equality.
7. Experimentation – promotes play, innovation, and a sense of discovery. (p. 81)

Congos (2002) also ties SI to Chickering's Seven Principles for Good Practice in Undergraduate Education. Chickering's second principle of encouraging cooperation among students, the third principle of encouraging active learning, fourth principle of prompt feedback, fifth principle of emphasizing time on task, and the seventh principle of respecting diverse talents are lived out in SI sessions as the students work together to arrive at their own solutions. SI also supports the sixth principle of communicating high expectations because the SI leader is not there to work the homework or lecture; the SI leader is there as a facilitator who guides the students to their own achievement. As the students work in this environment utilizing these principles of good practice, they are developing their own learning skills. This development leads to many benefits for the students, including satisfaction with their education (Congos).

Course attendance. The fourth outcome that SI seeks is good attendance in the class. Poor student attendance rates in developmental math courses are a major problem. Developmental courses in Virginia have a funding ratio of 15:1 which means that most classes have enrollments in the 20-25 students range (Waycaster, 2001). Waycaster found that the usual attendance rate for a developmental math class was 56% to 81% of the students, and attendance dropped to single digits in several classes as the end of the semester neared. This attendance problem is of special concern because regular attendance has been found to have a strong positive correlation to a student's final grade (Clump, 2003). This relationship has also been found to hold true in mathematics classes (Thomas & Higbee, 2000) and in developmental math (Wheland, Konet, & Butler, 2003).

There is a concern whether poor grades lead to increased absences or vice versa. Jones (1984) found support in both directions. Jones hypothesized a downward spiral where the more a student missed class, the worse he/she did, the more absences would result, leading to even worse academic performance. Clump (2003) was also able to verify this spiral effect of downward grades as absences increased while regular attendance resulted in an upward spiral with higher grades. Therefore, class attendance has been found to be essential for a student's success in a course.

In response to this research, developmental educators have been recommending more active learning and fewer lectures in the classroom. Boylan and Saxon (1999) are listed as a reference for best practices by the National Association of Developmental Educators and recommend a variety of instructional methods, including collaborative learning, for the developmental mathematics classroom in order to maintain the students' interest and involvement in the course material which should then prompt regular course attendance.

Metacognitive and study skills. Simply accomplishing a gain in mathematics skills will not help the student to be a better learner. Boylan (2002) advised that the developmental student must be treated as a whole individual who has cognitive processes that also need improvement. By focusing students' attention on how they learn and how they control their learning, developmental students can gain metacognitive skills that will last them beyond the present developmental course. The SI leader is in a position as a peer to lead students in the discovery of how they learn. The SI session can provide a non-threatening environment which allows students to try out different learning strategies and select those which work best for them (Blanc et al., 1983; Boylan, 1997; Congos, 2002, 2003; Congos & Schoeps, 1993). In this way, an improvement in metacognitive skills can lead to a long-range improvement in study skills.

Mandatory SI Session Attendance

Tying into the importance of regular classroom attendance is the importance of students attending SI sessions. Congos and Schoeps (1999) reported a usual attendance in SI sessions of only 25-30% of the students enrolled. Wright et al. (2002) only had 18.8% of the developmental mathematics students participate in SI sessions. Visor, Johnson, and Cole (1992) examined the non-cognitive factors of locus of control, self-efficacy, and self-esteem in relation to attendance at SI sessions. They found that students with the most external locus of control, the lowest self-efficacy, and the lowest self-esteem only occasionally participated in SI sessions. Visor et al. recommended that since these are the students who are probably the most at-risk, then colleges need to take steps to ensure that they attend the SI sessions.

The SI model has the instructor recommending regular SI session attendance to the students, and he/she is also to feature the SI leader in the classroom. However, Reittinger and Palmer (1996) found that motivating students to attend the sessions was a major problem. They used dropping a student's lowest quiz grade as an incentive for SI attendance; but this incentive did not increase their SI attendance. Reittinger and Palmer recommended a stronger incentive, perhaps dropping a student's lowest test grade. Other researchers have recommended requiring attendance at SI sessions (Hodges & White, 2001).

Several studies have used different forms of mandatory attendance at SI sessions. Allen, Kolpas, and Stathis (1992) investigated mandatory versus voluntary SI attendance for Calculus I students at a community college (in Hodges, Dochen, & Joy, 2001). They gave students in the mandatory sections a 10% increase in their grade for SI session attendance, and they found that students in the mandatory sections had final grades 20% higher than the voluntary SI sections (in Hodges et al.). Hodges et al. used the Friday session of a Monday, Wednesday, Friday class as the required SI session for some classes of history students and left other classes on voluntary SI attendance. They found that the mandatory SI group had a mean of 2.74 (on a 4.0 scale), the voluntary SI attendees had a mean of 2.49 and the non-SI attendees had a mean of 2.13 for their final grades. Ramirez (1997) made the SI session a one credit course for which students enrolled so that it became a part of the student's weekly schedule, and he found that on average specially admitted students who attended SI sessions had a 2.45 course grade (on a 4.0 system), while non-SI students had a 1.48 course grade. These greater achievements when SI sessions are required would seem to point to the importance of SI session attendance.

Summary and Critique

While supplemental instruction has been found to be effective in many different high-risk courses (Blanc et al., 1983; Congos & Schoeps, 1993), it has not been evaluated in developmental math at the community college level. While some community colleges use SI, they are using this method of learning assistance in the college transfer courses that have been identified as high risk (Wild & Ebbers, 2002). Some four year colleges and universities have used SI in developmental math (Wright et al., 2002), but their developmental students do not share the diverse characteristics of the community college's developmental students.

Given the success that SI has been found to have in impacting performance, retention, attendance, and metacognitive and study skills, Mid-Atlantic Community College adopted the model for its Title III grant to improve student success and retention in developmental courses. The grant was now in the fifth year of its five-year term, and a program evaluation was needed to asses its impact. The college would use the results of this program evaluation to make both summative and formative statements.

Program Evaluation

Program evaluation is a tool that has been evolving since the 1960s. Scriven (1967) defined *evaluation* in terms of judging the worth of a program (In Fitzpatrick, Sanders, & Worthen, 2004). The evaluator is helping the stakeholders to articulate their criteria for a program's evaluation and then guides the evaluation in the use of those criteria to judge the worth of the program. One of the reasons for evaluation is that many programs are expensive to maintain and performing an evaluation may lead to the continuation, adaptation or discontinuance of a program. Another reason for evaluation is to improve the results of the program. Even though a program may have been adopted as designed, it may need adaptations in order to serve the population for which it is being administered. Another purpose for evaluation is to add to the research knowledge base of a program. While the primary purpose of evaluation must be to find the worth of a program, evaluation also serves the research purpose of adding to knowledge in the field (Fitzpatrick et al.).

Program evaluation has also been found to be important for the success of remedial programs. Successful programs for at-risk students evaluated their efforts on a regular and systematic basis (Donovan, 1974; Roueche & Snow, 1977). Boylan, Bonham, Claxton, and Bliss (1992) found that program evaluation was positively related to student grades in remedial courses and with the long-term retention of remedial students. Additionally, programs were found to be more effective for remedial students when a combination of formative and summative evaluation was performed to refine and improve the program (Boylan, Bliss, & Bonham, 1997).

The Latin definition of the word *evaluate* is to strengthen (Briedenhann & Butts, 2005), and this facet will be used in the formative recommendations. In order to design this program evaluation, different frameworks of evaluation were considered. This section will consider four stages of evaluation theorists as have been identified by Briedenhann and Butts.

Stage One Theorists

Stage one theorists state that evaluation is a science where the priority is to determine truth (Briedenhann & Butts, 2005). These theorists will construct scientific-experimental models that have priorities of impartiality, accuracy, objectivity, and validity of information. A stage one evaluator does not seek stakeholder input and feels that such input may bias the evaluation process. In fact, these evaluators keep a distance from stakeholders to avoid compromising their integrity. Stage one theorists also do not place value on the usefulness of evaluation results. In fact, a stage one theorist performs the evaluation solely for the purpose of making a judgment on the program.

Stage Two Theorists

In contrast to stage one theorists, stage two theorists state that evaluators should identify and collaborate with users of evaluation findings in order to generate useful information from the program evaluation (Briedenhann & Butts). They will solicit input from stakeholders in order to identify the criteria used in the evaluation and value of the program being evaluated. Stage two theorists can be thought of as a middle-of-the-road group who serve both pragmatism and theory. These theorists will often use a mixed-methods approach where both qualitative and quantitative information is sought in the evaluation. Patton (1997) is one of the stage two theorists who believe that using both methods is important because each method has strengths and weaknesses that compliment each other. Stage two theorists value the usefulness of the information generated by the program evaluation. Patton (1997), who is best known for his *utilization-focused evaluation,* goes so far as to say that even though an evaluator's methods of data collection, design and reporting are excellent that if the results of the evaluation are not used, then the evaluation is a poor one.

Stage Three Theorists

Stage three theorists also emphasize that an evaluation must be useful. These theorists even advocate that an evaluator must return to the program and ensure that the results of the evaluation are being used. A problem with the stage three theorists is that they are so focused on the stakeholders and their needs that their evaluation criteria are often biased (Briedenhann & Butts).

Stage Four Theorists

Stage four theorists are far to the left of the middle-of-the-road stage two or even stage three theorists. Their reality is constructed from their own understanding and, as such, means that every person's reality will be different. These theorists state that the stakeholders must perform their own evaluation with the assistance of the evaluator. Their beliefs leave this form of evaluation open to criticisms that the evaluation is biased and without credibility (Briedenhann & Butts). Without credibility, the results of the program evaluation will not be used, and the evaluation itself is then without purpose.

The purpose of this study was to evaluate the SI program that had been adopted and used at Mid-Atlantic Community College. This evaluation was both summative and formative in its scope. First, the term of the Title III grant was ending and MACC needed a summative evaluation in order to report the impact of SI on its developmental mathematics program. Second, MACC hoped to continue the program and so the evaluation was formative as MACC adopted what was useful and adapted features that needed changing.

Utilization-Focused Evaluation

For this program evaluation, Patton's (1997) utilization-focused evaluation was selected. His middle-of-the-road approach appealed to the purposes of the MACC supplemental instruction evaluation. Patton suggested four reasons for performing an evaluation: (a) making judgments, (b) improving the program's effectiveness, (c) informing future decisions, and (d) providing information specific to the users of the evaluation. MACC sought information for each of these reasons as it prepared to evaluate the SI program in developmental math.

Making Judgments

Judgments were needed about the impact of the SI program on students' performance, retention, and metacognitive and study skills. With the input of the stakeholders, the evaluation was designed to yield results that informed the making of judgments about the impact of the SI program on MACC students. Boylan (2002) recommended that a program evaluation should involve the collection of data on course completion rates, grades, and retention when a developmental education program is evaluated. He also states that data should involve long-term effects of the developmental program on the students and their success in college.

Improving the Program's Effectiveness

The formative part of the evaluation was the report to inform what improvements could be made to improve the program's effectiveness. Donovan (1974) reported that developmental programs that evaluated their outcomes were more likely to be successful. Boylan, Bliss, and Bonham (1997) found that programs emphasizing the evaluation of their outcomes were more likely to retain students, and the success rates of those students in developmental courses would be higher. Utilization-focused evaluation was able to identify where and what improvements should be recommended.

Informing Future Decisions

Decisions should be made with a basis of information that is data-driven. All facets of education today are requiring assessments in order to continue or adapt programs. Fitzpatrick, Sanders, and Worthen (2004) stated that summative evaluation provides information that will assist in making judgments about adoption, continuation or expansion. Decisions were made to expand, diversify, or curtail the use of supplemental instruction at MACC based on the results of this program evaluation.

Providing Specific Information

With the involvement of stakeholders in the SI program from the beginning of the evaluation, MACC received the information that it needed to make these informed decisions. These stakeholders helped design the evaluation and were part of the response in evaluating some of the evaluation criteria, for example in focus groups. Stakeholders learned from other stakeholders and made recommendations that were included in the evaluation report. The specific users of the evaluation report gave greater credence to such a report that is based on stakeholder objectives and information from the evaluation process.

Summary and Critique

While Patton's utilization-focused evaluation matched the needs of MACC for making judgments, improving the program's effectiveness, informing future decisions, and providing specific information, such an evaluation of SI in developmental math had not been performed before at the community college level. While Blanc et al. (1983)

cited SI as a program that improves success in high-risk courses, and Ramirez (1997) found that under-prepared students in SI courses were retained at higher levels than non-SI students, MACC's application of SI to developmental math at the community college level was a new one for SI. Additionally, SI has been advertised by the University of Missouri at Kansas City to increase metacognitive and study skills (Blanc et al.). The assessment of that claim had not been confirmed by program evaluation or other research, and the MSLQ was used in this program evaluation to evaluate that claim (Pintrich et al., 1991).

Conclusion

Students are arriving at colleges in need of skills improvement in mathematics. When this deficiency is shown in a placement test, these students should be required to take the indicated developmental courses. Due to poor prior performance and attitudinal problems, the colleges need to be ready with programs that will address all of these students' needs, including deficiencies in study skills, hesitance to seek help, and poor attitudes toward mathematics. According to the literature, students who attend Supplemental Instruction sessions are retained at a higher level, have higher final course grades, and are more satisfied with their courses. In addition, a variety of learning techniques in the classroom and SI sessions help maintain students' interest and spur better attendance in courses. Supplemental Instruction has been shown to be especially helpful in these areas for students who have prior poor academic achievement.

Researchers who have been disappointed with the low level of voluntary participation in SI sessions have sought different methods to encourage this participation. SI session attendance is especially low in developmental courses. Very little research has been done at the community college level with the Supplemental Instruction model applied to developmental courses. The question of this program evaluation will be whether supplemental instruction in developmental mathematics will improve students' retention, achievement, study and metacognitive skills, and attendance in the course.

While having an effective SI program may have a reward of higher retention for the community college, the larger reward will be realized by the individual students and in turn the economy. Students who complete developmental courses will go on to enroll in other courses and eventually fulfill their educational goals. These students will then be able to have a long-term social and economic benefit as they attain higher-paying jobs. The United States is in need of a highly trained workforce to meet the demands of the changing world economy, and community colleges can help meet this need with these well-prepared students.

CHAPTER III

METHOD

In order to examine the implementation of the supplemental instruction method in developmental mathematics at Mid-Atlantic Community College, this research study utilized a program evaluation model to examine all the components of that implementation. By analyzing demographic characteristics of students, as well as learning gains, course completion, and persistence variables this research sought to identify the impact of supplemental instruction on developmental math students at the community college. In addition, student focus groups, faculty interviews and documents that reflect the nature of the supplemental instruction program were examined to find the nature of the implementation at Mid-Atlantic Community College. Finally, metacognitive and study skills variables were examined to evaluate the level of those skills in developmental math students. Permission to collect this data and perform the evaluation is included in a letter from Mid-Atlantic Community College included here as Appendix A.

As described in Chapter Two, Patton's (1997) Utilization-Focused Evaluation (UFE) provided a framework for the program evaluation and provided the basis for the research approach taken. The beginning of the UFE process was a clarification with stakeholders on their needs for the program evaluation so that the results answered the questions they had, and in turn, enabled those results to be used by those stakeholders. Goals for the program evaluation were defined in relation to the variables of the study. Each of these goals was evaluated by instruments and documents that have been found to be related to the subject matter and implementation of supplemental instruction. Intact classes of Algebra I developmental students were selected from those that used supplemental instruction and those that did not, thus indicating a quasi-experimental approach imbedded in this mixed methods design. Both quantitative and qualitative methods were used in data gathering and analysis.

These data gathering methods included a documents review, pre/post-testing the students, focus groups of students, interviews of faculty, and the administration of the Motivated Strategies for Learning Questionnaire. Qualitative methods were utilized to find themes and code data from the documents review, focus groups, and faculty interviews. Quantitative methods were used with the SPSS statistical software to produce descriptive and inferential statistics which examined the effects of the supplemental instruction program on the developmental math students.

Evaluation Design

The research design was a program evaluation which utilized Patton's Utilization-Focused Evaluation (UFE) for its framework with both quantitative and qualitative measures in a quasi-experimental format. With this set-up, this program evaluation then became evaluation research. Research is sometimes differentiated from evaluation because research is knowledge-oriented and evaluation is action-oriented (Patton, 1997). The aims of research are to discover new knowledge, test theories, establish truth, and generalize across time and space. Program evaluation that is data-driven has similar aims while also providing information to stakeholders in a particular program. Research can be evaluative in nature when it generates generalizable evaluation findings. In fact, program evaluation has a tradition of social-science research when it is applied in an academic setting (Patton). The next sections explain the chain of objectives model, the program evaluation site, the documents that were reviewed, the focus groups and interviews that were conducted, the algebra assessment that was used as the pre/post-test, and the Motivated Strategies for Learning Questionnaire.

The Chain of Objectives Model

Patton's UFE framework sets up a chain of objectives model where the immediate or implementation-level goal must be accomplished before the intermediate-level goal and likewise both of these levels would be accomplished before the ultimate or long-range goals (Patton, 1997). If the objectives in this chain are found to have been met, then the program can be defined as an effective one. The following sections explain the three goals in more detail, including how they were addressed in this study.

Implementation-level Goals

Using the UFE approach, implementation-level goals are associated with implementing the academic program as it was designed. Schwitzer, Duggan, Ericksen, Moncrief, and Nelson (2006), in designing an evaluation of a degree program in human services stated that creating satisfying, practical and meaningful classroom experiences was the implementation goal. Schwitzer, McGovern, and Robbins (1991) in evaluation of a freshman seminar identified the implementation goal as finding the level of satisfaction and effectiveness of the seminar for the participants. In the case of the supplemental instruction model, the implementation-level goal would be to find how the SI program was implemented at MACC in comparison to the design from the MACC Title III grant. The portion of the grant concerning SI required that the SI leaders receive training before beginning their SI duties, instructors were thoroughly briefed about the program and the use of the SI leader in and out of the classroom, and class sections were selected that had been identified as high-risk for student success (TCC, 2000).

Intermediate-level Goals

Intermediate-level goals are set to examine the successes of the students which result from providing the instruction as intended. In the program evaluation of the human services degree program the intermediate-level goal was to measure if students had acquired and demonstrated necessary professional skills, attitudes, and behaviors (Schwitzer et al., 2006). In the freshman seminar evaluation, the mid-level goal was to determine to what extent participants' level of knowledge about the university community and levels of social adjustment change over the course of the seminar (Schwitzer et al., 1991). In this program evaluation of supplemental instruction, the intermediate-level goal was to find the course completion rates, persistence rates, and learning gains for SI developmental mathematics students as compared to those for non-SI developmental math students.

Long-Range Goals

The long-range or ultimate-level goals refer to the long-term outcomes of the program. In the case of the human services degree program evaluation, the ultimate-level goal was student success in post-graduate work settings (Schwitzer et al., 2006). In the evaluation of the freshman seminar, the ultimate-level goal was to find the relationship between participation in the seminar and adjustment following the first semester of enrollment (Schwitzer et al., 1991). In this program evaluation of supplemental instruction the ultimate-level goal was to find what metacognitive and study skills that SI developmental math students have that will assist them in being successful in their future courses as compared to non-SI developmental math students.

The Program Evaluation Site

This study took place at a large community college in the Tidewater area of Virginia. As can be seen in Table 1, the cities of Chelsea and Beachside are part of the service area and have approximately the same characteristics with 70% white and 30% non-white (TCC, 2004), a median household income in the $50,000-$75,000 range (Fairdata, 1999), and 5% of the population aged 18-24 and 32% of the population aged 25-44 (TCC, 2004). The Beachside campus is 62% white and 38% non-white, and the Chelsea campus is 65% white and 35% non-white (TCC, 2006). The cities of Northland and Portville are also in the service area and have approximately the same characteristics with 50% white and 50% non-white (TCC, 2004), a median household income in some areas in the $50,000-$75,000 range while other areas only median household incomes in the $20K-$30K or even $0-$10K range (Fairdata, 1999), and 11% of the population aged 18-24 and 29% of the population aged 25-44 (TCC, 2004). The Portville campus is 55% white and 45% non-white, and the Northland campus is 42% white and 58% non-white (TCC, 2006). The average age of all MACC students is approximately 28 (TCC, 2006). The Tidewater area overall has an unemployment rate of 3.8% which is slightly lower than the 4% overall rate in Virginia (McWilliams, 2006). Therefore, the student population at MACC is representative of the region.

Table 1

Racial and Household Income Characteristics of Tidewater Area and MACC

City	Racial Breakdown	Median Household Income
Chelsea-Beachside Service Area	70% white	$50,000 - $75,000
Chelsea Campus/MACC	30% non-white	
	65% white	
Beachside Campus/MACC	35% non-white	
	62% white	
Northland-Portville	38% non-white	
Service Area	50% white	$0 - $75,000
Northland Campus/MACC	50% non-white	
	42% white	
Portville Campus/MACC	58% non-white	
	55% white	
	45% non-white	

Mid-Atlantic Community College is a multi-campus institution enrolling 35,000 students (15,000 FTEs) annually with four campuses in Chelsea, Northland, Portville, and Beachside (TCC, 2004). MACC has the largest share of higher education enrollment in the Tidewater area with 45% of all students enrolled in higher education being MACC students (TCC). The characteristics of the student population at MACC are 57% white and 43% non-white, 60% female and 40% male, and an average age of 29 years. In 2004, 1600 of the graduates from local area high schools enrolled at MACC with a need for remediation in one or more of the areas of reading, writing, or mathematics (TCC), and more than 70% of all entering students need remedial education before they can begin college transfer classes.

Documents Review

The researcher performed a documents review to study the implementation of the SI method at Mid-Atlantic Community College. A documents review was appropriate in this instance because the details of the implementation must be known in order to make the program outcomes relevant. These program outcomes cannot be generalizable unless the implementation of the program, as seen through its documents, was analyzed (Patton, 1997). Documents are personal or agency records that were not prepared specifically for evaluation use (Fitzpatrick et al., 2004). In fact, because of their informal nature, documents may reveal the perspectives of individuals and/or the group involved in the program. A documents review required qualitative methods analysis since these documents were being used as a data source (Fitzpatrick et al.). The documents reviewed in this study were the Title III grant itself, the SI leader time logs, the MACC SI website, and the Student Information System (SIS) generated grades and reenrollment data. These documents revealed and allowed comparison of the planned implementation to the actual implementation of the SI model. The following sections describe the various documents reviewed for this study.

Title III Grant

The first document that the researcher reviewed was the Title III grant itself. This grant was entitled *Strengthening Institutions Program – Creating the Conditions for Successful Student Achievement: Improving and Linking Developmental Programs and*

Student Services and was aimed at improving the developmental education program at Mid-Atlantic Community College. The grant application was submitted in 2001 to the U. S. Department of Education, and it was approved and funded for 2002-2007 in the amount of $1.5 million.

This grant had six broad objectives listed as follows:

1. At least 75% of all new students who show a need for developmental English and 50% showing a need for developmental math will enroll in and complete these courses in their first two semesters at the college.
2. At least 70% of students needing developmental English and 25% of students needing developmental math will accomplish these courses in a single attempt.
3. The retention rate from the first to the fourth semester for students who show a need for developmental courses will increase to 75%.
4. Graduation rates for those students who show a need for developmental courses will equal those of students who needed no developmental work.
5. Students who have completed developmental courses will perform as well in their programs as students who needed no developmental work.
6. All new students who show a need for developmental instruction will be offered an opportunity to enroll in a *Transition Year Program* and 60% of those will enroll in such a program.

The methods the grant used were supplemental instruction as a very different kind of tutoring, a learning assistance website, professional development for developmental faculty and a revised student orientation course. The grant proposal was treated as a living document whose treatments and activities were adapted as needed. The documents review of the grant proposal examined those activities that were directed at the supplemental instruction model to check the proposal against the actual implementation. The researcher used the grant document to collect information on the planned training of the supplemental instruction leaders, professional development activities for the faculty, and the plans for the SI website.

SI Leader Time Logs

Each SI Leader completes a daily time log that catalogs how he/she has spent working hours in the SI program on a biweekly basis. Categories include observing in the classroom, assisting students in the classroom, planning SI sessions, carrying out SI sessions, planning with the instructor, and training. Using these time logs as documents to be reviewed gave the researcher an insight into the daily activities of the SI program. By examining these documents, the researcher was able to compare the actual activities of the SI leaders to the ideal of the SI program. SI Leaders were paid for all of the time spent on the activities in the time logs, and this fact served as an encouragement for the leaders to catalog this information.

The categories in the time logs served as the codes for the thematic analysis. All time logs from all four campuses for the spring semester of 2007 were collected. When an SI Leader has participated in an activity for a category, that category received a value of 1. When the SI leader has not participated, then the category received a value of 0. The researcher compared categories across all time logs to find if there was a consistent pattern in these scores.

MACC SI Website

Included in the plan in the Title III grant document was a website for supplemental instruction. This website is now embedded in the MACC website under *Academic Development.* The components of this website are a) MACC Campus Resources, b) MACC Online Resources, c) Supplemental Instruction, and d) Additional Resources. Each of these portions of the website were examined for accuracy and compared to the ideas that were set forth in the grant proposal. While the requirements in the grant proposal could be adjusted according to the changing needs of the college, the website was evaluated according to the proposal.

Student Information System

Another portion of the documents review was an examination of student records in the MACC Student Information System (SIS). The dependent variables of course completion and persistence rates was measured by using the college's student information system to find the final grades of the students at the end of the semester and to record which students reenroll in the subsequent semester. Bers and Smith (1991) found that due to the nature of community college attendance patterns it is preferable to define persistence from semester-to-semester rather than from academic year-to-year.

Each of the students in the sample for the research project had their student identification number collected as their identifier for the study. At the completion of the spring semester of 2007, these student identification numbers were entered into the SIS and the student's grade was recorded as part of the research database. Course completion was recognized when the student earned a grade of Satisfactory (S). Non-completion was a grade of Withdraw (W), Repeat (R), or Unsatisfactory (U). On September 15, 2007 these same student identification numbers were entered into the SIS to check for student reenrollment in the fall semester of 2007. Students who had reenrolled in fall 2007 were counted as those who persisted, and students who were not enrolled were counted as those not retained.

Data analysis consisted of a percentage comparison of those students who successfully completed the course in the SI sections (treatment group) to those who successfully completed the course in the non-SI sections (control group). A limitation of this comparison is that students may fail because of the many competing priorities in their lives, and the SI model or lack of it would not have been relevant to that failure. Likewise, a percentage comparison will be made for those who persisted in the treatment group to those who persisted in the control group. A limitation of this comparison was similar to the limitation for the completion comparison. That is, students may not persist in college because of family or work responsibilities which would not have been affected by the SI model.

Focus Groups and Interviews

The researcher also used focus groups and interviews to better hear the voices of both students and faculty members involved in the program. DeLaOssa (2006) used focus groups to investigate students' perceptions about learning, knowing, and their school experiences. Her findings suggest that students are capable of providing valuable information and feedback about program and policy effects. Klingner and Vaughn (1999), noted researchers in the area of student inclusion, demonstrated that using student feedback to evaluate teachers and programs was valuable in improving educational quality. Sharma (2004) stated that focus groups are used for triangulation of findings which confirm, expand, and provide rich data in research.

Focus groups were used to collect qualitative data on the implementation of the model. Focus groups typically consist of eight to twelve individuals who make up a relatively homogeneous group (Fitzpatrick et al., 2004). The role of the leader is to facilitate discussion by posing beginning and follow-up questions, moderating the responses to allow all members to participate, and encouraging quiet members to participate. The key focus group characteristics are member interaction, openness, and exploration. A skilled leader uses issues raised by he members to stimulate discussion by the others in the group (Fitzpatrick et al.).

Student focus groups and separate faculty interviews were held on each of MACC's four campuses to investigate the implementation of the model. Information was sought in these focus groups and interviews on barriers the students and faculty have faced and what changes they would make in the SI program. Questions in the focus groups and interviews also attended to the subscales of the MSLQ (rehearsal, elaboration, organization, metacognition, time and study space, and self-effort). The faculty interview protocol is contained in Appendix B, and the student focus group protocol is contained in Appendix C.

On each campus, eight students from each SI class in developmental math in the spring of 2007 were selected at random and invited to participate in a focus group. The researcher scheduled these focus groups either directly before or after the SI class. Breakfast, lunch, or dinner was provided for the attendees. The qualitative data gleaned from these focus groups was recorded on an audio recorder as well as written on flip charts during the focus groups themselves. The researcher followed the protocol listed in Appendix C in order to maintain consistency with all focus groups.

On each campus, faculty members who have been the instructors in multiple classes with SI leaders were interviewed individually. The researcher scheduled these interviews at the convenience of these faculty. As with the student focus groups, their responses were recorded on an audio recorder as well as written on a response sheet. The researcher followed the protocol listed in Appendix B in order to provide consistent results on all four campuses.

Student results from all focus groups were compared and contrasted to discover themes in the responses. In order to organize the responses, a table was constructed to place all responses in parallel. Next, thematic analysis was used to discover patterns. Next, patterns were labeled as themes. Last, the patterns were interpreted as codes (Boyatzis, 1998). The codes for the student responses were based on the cognitive, metacognitive, and study skills of the Motivated Strategies for Learning Questionnaire. Even though the codes were based on the MSLQ and its prior research, the interpretation was still inductive because of the application of the MSLQ to the Supplemental Instruction model.

In order to have inter-rater reliability on the codes, the researcher enlisted a co-facilitator who is a fellow doctoral student to attend all the focus groups. The researcher and the co-facilitator completed training with Dr. Molly Duggan in order to attain inter-rater reliability. The co-facilitator interpreted the information gathered to check for consistency. The presence of the co-facilitator also served to limit researcher bias. This researcher was very familiar with the supplemental instruction method, and the presence of the co-facilitator prevented projection of the researcher's knowledge onto the participants in the focus groups (Boyatzis, 1998).

Algebra I Assessment

An Algebra I Assessment Test was given as a pre/post-test to a sample of student enrolled in Math 3. The subjects were to be approximately 400 students enrolled in twenty sections of Math 3 (Elementary Algebra) at the four campuses of Mid-Atlantic Community College. The cover sheet on the pre-test collected the student's SIS identification number which was used throughout the study. The researcher selected ten of the sections from day classes and ten from night classes. Five of the day sections were SI-sections, and five were non-SI sections with the same split for the night classes. Math 3 is a developmental (remedial) course for which students receive mandatory placement based on their assessment test results (Compass). By their low scores on the assessment test, these students were indicated as under prepared for college level math courses. Students self-selected their class section, and the researcher randomly assigned sections to be included in the study.

Subjects in all sections took the pre-test of their algebra skills on the first or second day of class. The instructor in the selected class section administered the test using the directions that are printed on the cover of the test (see Appendix D). In a quasi-experimental design such as this one, the pre-test was critical to establish the equivalence of the control and treatment groups (Orcher, 2005; Campbell & Stanley, 1963). The more the similarity of the groups was confirmed by the pre-test, then the more likely it becomes that effects can be attributed to the independent variable. It was also important to collect demographic information on all subjects in order to establish the equivalence of the groups (Orcher).

The purpose of the test was to ascertain if the classes have essentially the same level of algebra achievement at the beginning of the study. The cover sheet also asked for demographic information on the subject's age, race, gender, enrollment status (part-time vs full time), and work status (number of hours worked per week). This test was a researcher-created instrument which was pilot-tested with students who had successfully completed the course. The pre-test was also given to a committee of mathematics instructors for expert review to check for content validity and then re-formatted as necessary. This same pre-test was given at the end of the course as the post-test. As with all such researcher-created instruments, there could be a limitation of criterion-related validity that should be reduced by performing the pilot test and expert review (Orcher).

The pre/post-test consisted of 25 questions in a multiple-choice format which students had 30 minutes to complete. The selection of the 25 questions was made in accordance with the objectives for the Algebra I developmental course. These objectives were agreed upon by the math faculty of MACC in a college-wide symposium. The decision of the researcher to use an instructor-created test was based on the wide variability of objectives in Algebra I classes across the United States. Orcher (2005) advised that the threat to validity of using an instructor-created test was reduced by forming the test from the objectives and having reviewers check the test against those objectives.

In order to determine the learning gain of the students, which was one of the dependent variables, grades were compared for the control and treatment groups. Since assignment of partial credit in mathematics problems can lead to problems of scorer reliability, the pre- and post-tests were in multiple choice format with no partial credit given. The pre/post-test to be used for the Algebra I assessment is included as Appendix D.

Also, an analysis of covariance was used to examine what SI contributed to their algebra understanding over and above the level with which the subjects entered the study (Congos & Schoeps, 1999). For this analysis, the pre-test score was a covariate, and the SI and non-SI groups were compared for achievement after their final grades had been statistically adjusted for the difference in incoming algebra achievement. A significant difference indicated if the SI group had a different benefit in developmental math attainment than the non-SI group with the covariate pre-test causing a level beginning point for the two groups.

Motivated Strategies for Learning Questionnaire

The Motivated Strategies for Learning Questionnaire (MSLQ) was given to all class sections in the study during the twelfth week of the semester by the instructors in the sections selected for the study. These instructors administered the survey using directions printed on the instrument. This questionnaire was developed by Pintrich, Smith, Garcia, and McKeachie at the University of Michigan in the early 1980s. Permission to use this instrument was obtained from the University of Michigan and was indicated as such in a memorandum (Appendix E). This instrument was selected because of its reputation for accuracy as well as its validity and reliability. The SI model claims to increase students' metacognitive and study skills, but this claim has not been tested. By using this accurate, valid, and reliable instrument, students' metacognitive and study skills in the SI sections were compared to those in the non-SI sections. In order to measure the impact of the SI model on students' metacognitive and study skills, the MSLQ was used. The MSLQ measured motivation and learning strategies.

The MSLQ consists of a motivation section and learning strategies section. The motivation section has 31 items that assess students' goals and value beliefs for a course, their beliefs about their skills to succeed in that course, and their anxiety about tests. The learning strategy section has 31 items that measure students' use of different cognitive and metacognitive strategies. The learning strategies section also includes 19 items concerning student management of different resources. The items on the MSLQ are scored on a 7-point Likert scale with 1 meaning *not at all true of me* and 7 meaning *very true of me*. In all there are 15 different scales on the MSLQ which can be used together or separately. As with all surveys, there was a limitation on the results of the survey because the students are giving their opinions of their own behavior (Fitzpatrick et al., 1997). This limitation was reduced because each sub-scale has 4-5 questions addressing that component. The ratings on those questions were averaged to produce a score for that subscale (Pintrich et al.). One of the most frequent uses of the MSLQ is to evaluate the effect of a course on a student, and the MSLQ (Appendix F) has been widely used since its creation.

The MSLQ was designed to be applied at the course level to evaluate the effects of a course on the students. The MSLQ has been used to assess the motivational and cognitive effects of different aspects of instruction including instructional strategies (Barise, 2000; Wilke, 2003), coaching (Hamman, Berthelot, Saia, & Crowley, 2000), reciprocal peer tutoring (Rittschof & Griffin, 2001), and cooperative learning (Hancock, 2004). The MSLQ has also been applied to content areas such as undergraduate statistics (Bandalos, Finney, & Geske, 2003) and undergraduate chemistry (Zusho, Pintrich, & Coppola, 2003).

The MSLQ is based on a general cognitive view of motivation and learning strategies with the student pictured as an active processor of information whose beliefs mediate the input of instruction (Pintrich et al., 1993). This instrument was developed at the University of Michigan as part of the National Center for Research on Improving Postsecondary Teaching and Learning (NCRIPTAL) activity starting in 1982 as an evaluation of a *Learning to Learn* course. Earlier versions of the MSLQ were subjected to statistical and psychometric analyses, including internal reliability coefficient computation, factor analyses, and correlations with academic performance and aptitude measures. The items on the MSLQ were then adapted based on the results of the analyses with this final version reflecting 10 years of revisions. The fifteen different scales on the MSLQ can be used together or singly as the researcher needs (Pintrich et al.).

For this research study, only the nine sub-scales of cognitive, metacognitive, and resource management were used comprising 50 questions which the students completed. In order to determine how well the MSLQ model fit the data, several statistics have been calculated on the MSLQ: the chi-square to degrees of freedom ratio ($\chi 2/df$), the goodness-of-fit (GFI) and adjusted goodness-of-fit (AGFI), and the root mean residual (RMR). A $\chi 2/df$ ratio of less than 5 is considered to be a good fit between the observed and reproduced correlation matrices. For the 50 items on the cognitive, metacognitive, and resource management scales, the $\chi 2/df$ ratio was 2.26 thus yielding a good result on this measure of goodness-of-fit. A GFI or AGFI of .9 or greater and a RMR of .05 or less also indicate that the model fits the input data well. The cognitive, metacognitive, and resource management scales had a GFI of .78, an AGFI of .75, and a RMR of .08. While these results do not indicate an excellent goodness-of-fit, they do show a good result (Pintrich et al.).

As can be seen in Table 2, the coefficient alphas for the learning strategies scales are reasonable, with most of the scores above .70. The rehearsal strategies and effort regulation subscales had identical alphas (.69), and organizational strategies had a somewhat lower alpha of .64. Help-seeking had the lowest alpha value (.52). The sub-scales of rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment management, and help-seeking were all distributed normally, with effort regulation negatively skewed and peer learning positively skewed. Correlation analysis showed that students who relied on deeper processing strategies like elaboration, organization, critical thinking, and metacognitive self-regulation were more likely to receive higher grades in the course. Rehearsal strategies were not correlated significantly with final grade, suggesting that a reliance on surface processing strategies was not helpful for student success. Students who successfully manage their own time and study environment and effort were more likely to perform better while peer learning and help-seeking were not significantly related to course performance (Pintrich et al.).

Table 2

Descriptive Statistics for the Learning Strategies Sub-Scales of the MSLQ

Sub-Scale	*M* (*SD*)	Coefficient α	*r* with final course grade
Rehearsal	4.53 (1.35)	.69	.05
Elaboration	4.91 (1.08)	.75	.22
Organization	4.14 (1.33)	.64	.17
Critical Thinking	4.16 (1.28)	.80	.15
Metacognitive Self-Regulation	4.54 (.90)	.79	.30
Time and Study Environment Management	4.87 (1.05)	.76	.28
Effort Regulation	5.25 (1.1)	.69	.32
Peer Learning	2.89 (1.53)	.76	-.06
Help-seeking	3.84 (1.23)	.52	.02

Based on these results, the MSLQ seems to have good reliability in terms of internal consistency and to be valid based on factor analyses. Therefore, the MSLQ was a good measure for assessing the use of learning strategies in a college classroom.

Evaluation Research Questions

Using Patton's Utilization-Focused Evaluation model, the research questions were directed toward the implementation-level, mid-level, and ultimate-level goals of the supplemental instruction program. Since these goals formed a chain of objectives where satisfaction of one goal depends on the satisfaction of the goals in the level before, the research questions took on a hierarchical framework.

Implementation-level Goal

Implementation-level goals are set to determine if the program being evaluated is operating as planned. The University of Missouri at Kansas City has stressed that SI programs must be implemented according to their directions (TCC, 2000). Therefore for the implementation-level goal, the application of their requirements for the SI leaders, their training, and SI sessions must be evaluated at MACC to determine how well the current program follows the guidelines established by UMKC and incorporated into the Title III grant. The Title III grant proposal, the SI Leader time logs, the SI website at MACC, the focus groups with students, and the interviews with instructors were the sources of data that answered the implementation-level goal research question which was as follows:

1. Has the supplemental instruction program been implemented at MACC as designed?

Mid-level Goal

Mid-level goals are associated with determining what successes the program is having. To evaluate the mid-level goal this program evaluation sought information on success and persistence rates of the students in the developmental mathematics program at MACC. Data which was used to evaluate the mid-level goal were results of the post-test, final grades, and persistence rates from the student information system. To investigate this mid-level goal the research question was as follows:

2. What was the impact of SI on the course completion rates, persistence rates, and learning gains for SI developmental mathematics students as compared to those for non-SI developmental math students?

Ultimate-level Goal

Ultimate-level goals refer to long-terms outcomes of the program. The ultimate goal for developmental students was that they have metacognitive and study skills that will enable them to be successful in their college transfer classes (TCC, 2000). The supplemental instruction program was designed to increase a student's metacognitive and study skills by making him/her an independent learner (TCC). Data from the MSLQ sought to show whether or not students had attainment of these metacognitive and study skills in the SI and non-SI groups. The ultimate-level goal was that a student gains these skills, and the research question to guide the investigation was

3. What metacognitive and study skills do students have that will assist them in being successful in their future courses?

Procedure

Twenty sections of developmental Algebra I (Mth 3) were selected in December, 2006. Four sections were selected from each of the Chelsea, Northland, and Portville campuses, and eight sections were selected from the Beachside campus. Half of the sections on each campus were day sections, and half were night sections. Also, half were SI sections and half were non-SI sections. Random assignment of sections to the study was made by placing section numbers in a container and drawing them out. Instructors of the selected sections were asked whether they wanted to participate in the study, and interventions of instruments in the classroom were explained. Only those instructors who consented to participation were included in the study. Those instructors received training in the use of the Algebra I Assessment Test and the MSLQ in the first week of January, 2007 before classes began for the spring semester. The researcher reviewed instruction sheets with the instructors to maintain consistency of test administration across instructors and campuses.

The Algebra I Assessment Test was given as a pre-test on the first or second day of the semester in all the selected sections. The instructors read the instructions on the cover sheet of the test, allowed the students to fill in their demographic information, allowed 30 minutes for the test, collected the completed tests, and the researcher collected the tests from the instructors. Demographic data on age, gender, race, full-time versus part-time enrollment, and number of hours worked per week was obtained on the answer sheet to the pre-test and maintained in the subject's profile in a database. This test determined the algebra achievement of the subjects at the beginning of the study, as well as being used to determine the possibility of any students who were misplaced in the course. Students scoring 80% or better on the pre-test had their scores communicated to their instructor with a recommendation that they be allowed to drop the course and move up to the next developmental algebra course (Mth 4). These scores as well as the post-test score were recorded in the database.

The MSLQ was given in week 12 of the semester by the instructors in the selected sections. The instructor read the instructions on the MSLQ, and the students had approximately 30 minutes to complete the measure or were allowed to take the measure home to complete. All students in both the treatment and control groups were given this questionnaire. As with the other measures in the study, the students entered their student identification number on the questionnaire for tracking purposes only. The completed MSLQ instruments were given to the researcher to score and to be recorded in the database.

Also in the twelfth week of the semester, students from each of the campuses were invited to attend focus groups. Attention was shown to selecting students who were representative of the make-up of the developmental math students at MACC. These students were randomly selected from each of the SI sections and invited to attend focus groups (discussions session) on their campus. The same protocol was followed for each of the focus groups, and responses were recorded by audiotape and flip chart. A co-facilitator assisted the researcher in recording the input from the students and in interpreting the responses. Faculty members from each campus who have participated in multiple SI sections were interviewed to gather their response and input about the supplemental instruction method.

The post-test was administered on the last or next-to-the-last week of the semester by the instructors in all the selected sessions. This test was the same test that was given on the second day of class with the same instructions and a time limit of 30 minutes. Completed tests were returned to the researcher to score, and these results were recorded to be compared to the pre-test scores to measure learning gains.

In May, 2007, after grades were recorded, final grades were used to measure course completion rates. The researcher accessed the student records in the SIS system using the students' identification number. Those students with a grade of S (Satisfactory) were recorded as completing the course. Students with all other grades (U, R, or W) were recorded as non-completers. Reenrollment the next semester was also researched on September 15, 2007 in the student information system and was used to measure persistence rates. Students who have reenrolled and stayed enrolled at least until September 15 were counted as persisting. Those students who were not enrolled on

September 15 were counted as not persisting. In October 2007, instructors were contacted to give final numerical grades for all students.

The identity of all subjects was kept strictly confidential and information was only reported as group data. The researcher obtained an exemption from the Old Dominion University Institutional Research Board for human subjects' research prior to the beginning of the study. All completed instruments were kept in a locked file cabinet and destroyed after the completion of the research. Care was taken to treat each participant and subject with respect and dignity, and standards of ethical practice were maintained throughout the study.

Limitations

This research was performed to evaluate the supplemental instruction program at MACC. Threats to the validity, both external and internal, were considered and controlled as much as possible. As a research study, it was important to have external validity in order to be able to generalize the results to a population (Orcher, 2005). Internal validity was important because the researcher needed to be confident that the differences observed in a sample resulted from the treatment, in this case supplemental instruction. Each of the threats in this study was considered below.

Generalizability

This study was performed at all four campuses of a multi-campus community college which had both urban and suburban settings. The results might not be generalizable to other community colleges or other institutions of higher education. This threat to external validity was lessened by the presentation of statistics on the demographics of the students and their pre-test scores. These statistics allowed other colleges to compare their college populations to the subjects in this study and determine if the program might produce the same results in their populations.

Self-selection of Subjects

Another threat to external and internal validity was the self-selection of the subjects into the two groups (SI versus non-SI). Randomly assigning courses across all four campuses and using both night and day classes reduced this bias. A comparison of the pre-tests scores for the two groups established whether or not they are equivalent at the beginning of the study in terms of prior algebra achievement.

Attrition

As Waycaster (2001) reported, attrition was a threat to internal validity in developmental mathematics courses. Also, differential attrition may be a problem if one group has a significantly higher withdrawal rate than the other group. Given that retention was a dependent variable in the study, the researcher looked for differences in retention in the two groups. In terms of the achievement variable, if differential attrition occurred, then comparative members of the other group could be eliminated in the statistical analysis of the study.

Diffusion of Treatment

Diffusion of treatment could have been a threat to internal validity because members of the control group could voluntarily attend SI sessions as much (or more) than students in the treatment group. While it is unlikely that all the members of the control group would elect to attend as often as the treatment group, it was still a possibility. Attendance will be taken in the SI sessions, and the director of the Title III grant informed the researcher of students in the non-SI sections who attended the SI sessions.

Students in the non-SI sections who opt to attend the SI sessions were factored out of the study.

Treatment Fidelity

Treatment fidelity was also a possible threat to the internal validity of this study. Instructors, who have used an SI leader in the past but who do not have an SI leader this semester, may have adopted teaching methods that would improve their students learning in an amount comparable to those in the SI sections. On the other hand, instructors may have an SI leader in their classrooms that they are not using to full effect, and thus they would lessen the positive effect of having that SI leader.

Instructor-made Test

An instructor-made test such as the Algebra I Assessment was a threat to the internal validity of the study because of the wide variability of these kinds of tests. There were, however, steps that the researcher took to reduce this threat. Scorer bias was eliminated by making an objective test, and the distracters were plausible so that the answers to the test were not obvious. The items of the test were referenced to the objectives of the material being studied in the course. The test underwent an expert review and revision, and the test was pilot-tested with participants who were not selected in the study (Orcher, 2005).

Researcher Bias

A researcher's philosophy or personal feelings about a program could bias his/her evaluation of that program. In addition, this researcher had been substantially involved in the supplemental instruction program from its inception and could have found it difficult to maintain her impartiality. To lessen this bias, the Algebra I Assessment test and the

MSLQ were objective measures. The focus groups and interviews were monitored by the researcher and co-facilitator, thus providing a check and balance.

Conclusion

This mixed methods program evaluation used Patton's Utilization-Focused Evaluation framework to collect both qualitative and quantitative data to evaluate the impact of the independent variable of supplemental instruction on developmental Algebra I students at Mid-Atlantic Community College. Qualitative data was analyzed to find patterns and themes to describe the dependent variable of the implementation of the supplemental instruction program. Quantitative data was analyzed through the SPSS statistical program to describe the dependent variables relating to course completion, satisfaction, learning gains, persistence rates, and metacognitive and study skills. SI classes were compared and contrasted to non-SI classes to determine the effects of the SI program throughout the study.

At the conclusion of the study, recommendations were made to the stakeholders at Mid-Atlantic Community College about the future of supplemental instruction at the college. Research has shown that SI has the potential to increase learning and retention in high-risk courses. If these claims were found to hold true at MACC, the students would be successful and be retained who otherwise would have left college. With these successful students earning degrees and higher salaries, they contribute to the economic welfare of their communities and their country. In addition, if SI was found to be successful, this program could be applied at MACC in other high-risk courses besides developmental math, thus further increasing the success of students.

CHAPTER IV

RESULTS

The following chapter presents the results of the program evaluation in the context of the research questions presented in Chapter One. This chapter begins with a review of the data collection methodology, a discussion of the stakeholders, and a presentation of pertinent demographic information for each group. Presented next are the three research questions following Patton's chain of objectives model. Variables associated with the study are addressed within the context of the research questions. The statistical procedures used in the study and findings related to each research question are presented next. Finally, the researcher summarizes those findings within the program evaluation format of the study.

Review of the Data Collection Methodology

Algebra I Assessment

Content validity. In December 2006 the researcher distributed the Algebra I Assessment Test to 20 math professors on the four campuses of MACC for them to assess the content validity of the instrument (Appendix D). Each of these full-time professors had taught the Algebra I developmental class at MACC for at least four semesters, and each had a master's degree in mathematics. These professors were asked to compare the contents of the test with the instructional objectives in the curriculum guide for Algebra I to determine if the test appropriately assessed those objectives. Seven of those professors responded, and they affirmed that the test accurately assessed the skills taught in the Algebra I developmental course.

Reliability. In order to determine the reliability of the Algebra I Assessment Test, in December 2006 the test was administered to a group of volunteers from the Portville campus of MACC who had successfully completed Algebra I (MTH 3) at MACC in fall 2006. This group of 15 students first took the test in the 30 minute time limit. Following this test they were asked for comments, and all of the students affirmed that the test did assess the material in the class that they had just completed. All but one of the students scored 80 or above with that student scoring 72. This classroom test of the instrument served to establish its reliability as a measure of Algebra I knowledge.

Administration. Before the start of spring classes, in early January 2007, the researcher contacted each of the 20 professors who had agreed to participate in the study. The researcher explained that the answer sheet to the test contained requests for demographic information and should be distributed first. Students were to be given time to complete the demographic information before the test was distributed. Following the completion of this information, the students were to be given 30 minutes to complete the test. The researcher instructed the professors to administer the Algebra I Assessment Test (Appendix D) during the first week of class. Students were to be told that their participation was voluntary, and that scoring 75% or better on the test could exempt them from this non-credit developmental course, advancing them to the next course. The professors administered the test as described and sent the completed tests to the researcher via college messenger mail. The researcher emailed the student results to the instructors. Each student's college identification number served as his/her identification number for this instrument and the other measures throughout the study.

Documents Review

The researcher also began a documents review of the Title III grant in January 2007 which continued throughout the spring and summer semesters. The grant proposal encompassed developmental math and developmental English as well as developmental student interaction with Student Services. The researcher focused the review of the grant on the portions dealing with the application of supplemental instruction in developmental math. At that time the researcher arranged to secure copies of the SI Leaders time logs throughout the spring 2007 semester. Additionally, the researcher reviewed the website for learning assistance that was funded through the Title III grant to examine the implementation of the supplemental instruction model.

Focus Groups

The researcher conducted focus groups with the six SI MTH 3 classes in early April 2007. The Moderator's Guide for Student Focus Group (Appendix C) was followed in each of the groups. The researcher was the facilitator of the groups with a fellow doctoral student as co-facilitator. Ten students were randomly selected from each of the SI classes and sent invitations to the focus group. These groups were scheduled either before or after the class time, and refreshments were served. Four students attended each of the two focus groups at the Portville campus; ten students in one and six in another focus group attended at the Beachside campus; and ten students attended the Northland campus focus group. Responses to the focus group questions were recorded on a mini-recorder and also on flip charts. After all focus groups were completed, the facilitator and co-facilitator transcribed all the responses into a chart, coded student responses, and identified themes.

Motivated Strategies for Learning Questionnaire

In April 2007 the researcher distributed the Motivated Strategies for Learning Questionnaire (MSLQ) to all instructors of the sections in the study. The researcher contacted each of the instructors to explain the purpose of the instrument, the rating system, and administration of the instrument. The instrument (Appendix F) contains 86 questions to which the students responded on a seven-point Likert scale ranging from 7 (very true to you) to 1 (not at all true to you). The respondents were to be untimed, and instructors were told that students could take the assessment home and return it if the instructors wished to do so to save instructional classroom time. For all classes in the study, the researcher distributed 296 MSLQ instruments, of which 99 were completed and returned (a return rate of 33%), 48 in the SI sections and 51 in the non-SI sections. The instructors forwarded the completed instruments through messenger mail to the researcher.

Algebra I Assessment (Post-Test)

In late April 2007, the researcher re-distributed the Algebra I Assessment Test to the instructors to serve as a post-test of skills. The researcher contacted each instructor to review the administration of the test. As with the pre-test, the answer sheet was distributed first for the students to fill in the demographic information. Next, the students were given 30 minutes to complete the 25 multiple-choice questions, and the instructors forwarded the completed tests to the researcher through college messenger mail.

Student Identification System

Following the end of classes in May 2007, the researcher used the student identification system to determine each student's final letter grade. After determining that this measure did not give enough information to perform certain statistical tests on the data, the researcher collected the final numerical grades for the students from each of the instructors in October 2007.

Faculty Interviews

In summer 2007 the researcher interviewed the faculty who had SI sections involved in the study individually. The Interview Guide for Faculty (Appendix B) was used for each of the interviews. The researcher recorded responses on the interview sheets and with a mini-recorder. After all interviews were completed, the researcher transcribed responses into a table. The co-facilitator and the researcher then identified themes and codes from this qualitative data collection.

Retention Data

In September 2007 the researcher used the Student Information System to identify which students had registered for classes in fall 2007 at MACC. It was past the add/drop date for fall classes, and students registered at this time were considered to be retained for the purposes of the study. This last data point completed the data base for the students which had been recorded in SPSS. Following this data collection, the student identification numbers were deleted from the data base thus rendering individual identification of students impossible.

Stakeholders

Student Groups

The researcher randomly selected 10 MTH 3 SI classes and 10 MTH 3 non-SI classes December 2006 to be included in the study. The researcher selected these sections by writing the section numbers of all face-to-face instruction MTH 3 classes on slips of paper and putting them into two containers. These containers were marked SI and non-SI, with the SI classes having been identified by the coordinator of the Title III grant. Once sections were selected, all instructors were contacted to identify whether or not they would agree to participate in the study. Participation in the study was voluntary, and two instructors refused to participate. The researcher removed their three sections from the study and drew additional sections to replace them.

With the understanding that all twenty sections would be included in the study, in the first week of January 2007 the researcher sent out the first instrument to be administered in the classroom, the Algebra I Assessment, which served as the pre-test of algebra skills. Only thirteen of the sections administered this pre-test and returned it to the researcher. These thirteen sections, six being SI and seven being non-SI became the research sections for this study. No SI sections from the Chelsea campus returned the Algebra I Assessment, but one section of non-SI did participate from the Chelsea campus. Three sections of SI participated at the Beachside campus, but only one non-SI participated from Beachside. One Northland section participated in the SI group, and three Northland sections participated in the non-SI group. Two sections participated in the SI group from Portville, and two sections participated in the non-SI group from Portville.

There were a total of 296 students between the two student groups. The treatment, or SI group, had 138 students in its six classes. The control, or non-SI group, had 158 students in its seven classes. Students did not know at registration whether the section for which they were enrolling was SI or non-SI. In fact, most students knew nothing about the SI program until it was explained to them on the first day of class. Student attendance on the day that instruments were administered and the students' willingness to voluntarily participate meant that not all students responded to all instruments. For example, for the Algebra I assessment in the SI classes, 106 of the 138 students participated and in the non-SI classes, 103 of the 158 students participated.

Faculty

Of the five faculty who taught the six sections in the study from the SI classes, two were full-time and three were adjunct faculty. Four of those five had master's degrees with at least 18 graduate credits in mathematics. The sixth, who was an adjunct for MACC, had a bachelor's degree in math and a full-time job as a high school mathematics teacher.

In the group of seven faculty who taught the seven non-SI sections in the study, two were full-time and five were adjunct faculty. Five of the seven had master's degrees with at least 18 graduate credits in mathematics. The sixth was a retired high school mathematics teacher, and the seventh is a current high school mathematics teacher.

SI Leaders

The researcher contacted the coordinator of the Title III grant to review the SI Leaders in the six SI sections of the study. There were two different SI Leaders in the two SI sections at the Portville campus, one SI Leader for the Northland campus, and two SI Leaders in the three SI sections at the Beachside campus. According to the Title III coordinator, all SI Leaders had been MACC students and were either completing their degrees or had graduated (S. R. Harrell, personal communication, May 15, 2007). Additionally, all had been SI Leaders in MTH 3 (Algebra I) for at least three semesters.

Group Demographics

The Algebra I Assessment pre/post-test collected demographic data from both the SI and non-SI groups. Students were asked for their age, race, gender, enrollment, and work status. The researcher established the following information with the demographic data: 1) that the SI and non-SI groups were approximately the same in their demographics and 2) that the groups were representative of the MACC population overall.

Age

For the demographic factor of age, the researcher found that most of the students in the developmental math research groups were in the 18-23 years old group. Figure 1 is a clustered bar graph showing the SI and non-SI groups in a side-by-side comparison. While the non-SI group did have more students than the SI group (92 vs 74), the percent of students in the 18-23 years old group was similar (58.2% vs 53.6%). Likewise all the other groups had similar percents of students in each age group. Using ANOVA in SPSS, the means of the SI and non-SI groups were compared and found $F(1, 1.35) = .87, p = .35$. Therefore, the two groups were not significantly different in the distribution of ages within the group. The average age of a MACC student in spring 2006 was 28.2 years. The average age group for this research study was the 24-29 age group, so the students in the research study were representative of the MACC population (TCC, 2006).

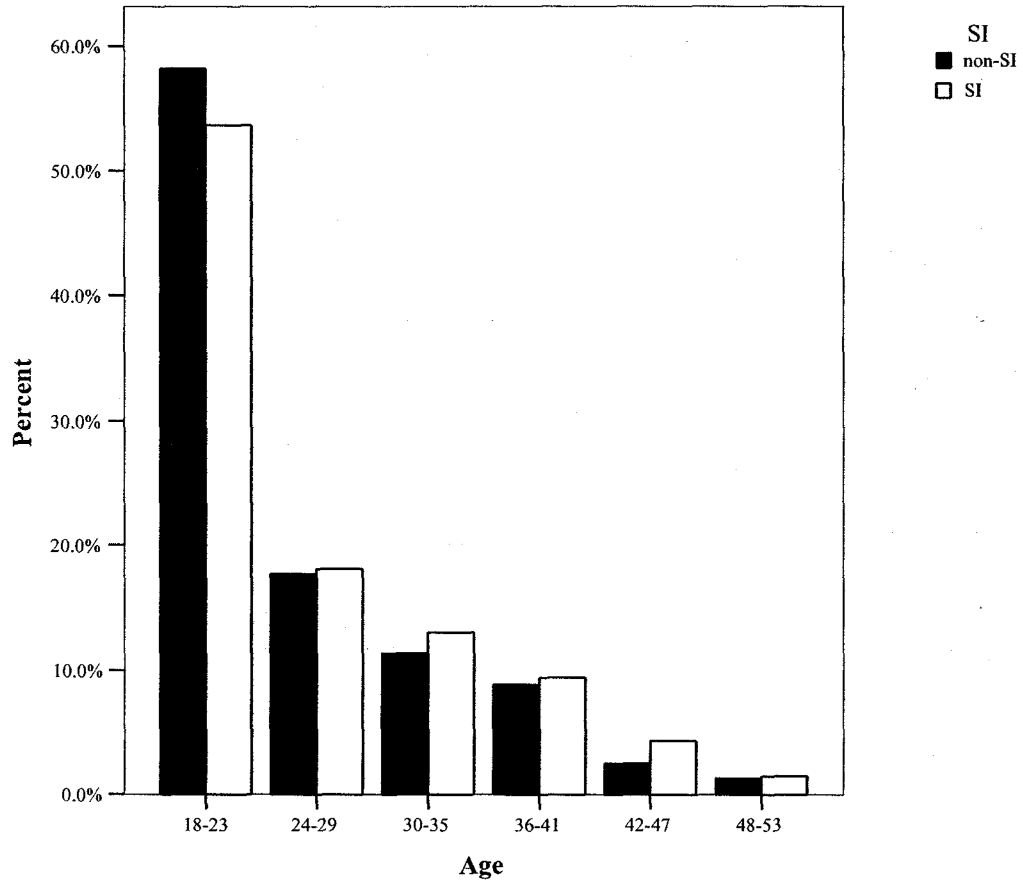

Figure 1: A Comparison of SI and non-SI groups by age

Race

Under the demographic variable of race, most of the students fell into the White and Black categories. Figure 2 shows the racial breakdown of the students in both groups. The non-SI group had a slightly lower percentage of white (32.9% vs 42%, as compared to 56% in MACC overall) and a slightly higher percentage of black (38% vs 31.9%, as compared to 31% in MACC overall) than the SI group (TCC, 2006). Again, the two groups are seen to be basically equivalent in race. Using ANOVA in SPSS, $F(1, .00) = .00$, $p = .99$, showing that the SI and non-SI groups were not significantly different in the racial composition.

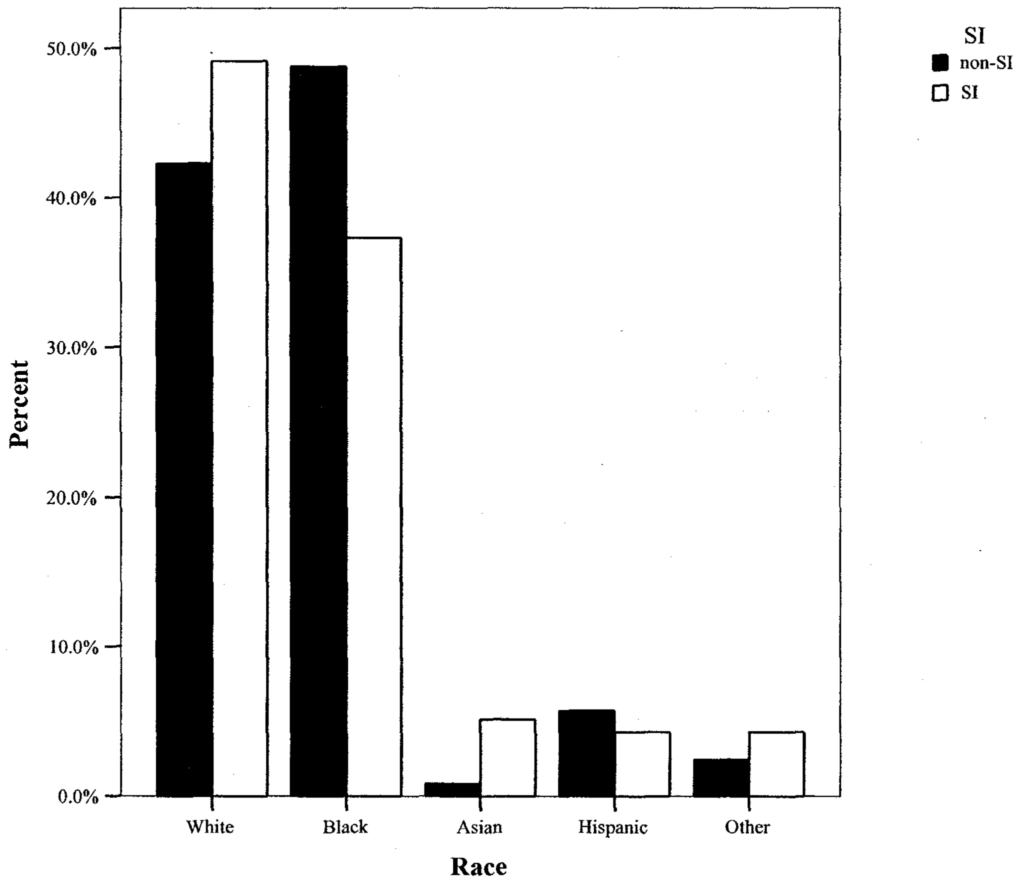

Figure 2: Comparison of SI and non-SI groups by race

Gender and Enrollment

Likewise, the non-SI and SI groups were equivalent in gender and enrollment status. The non-SI group was 63.9% female and 36.1% male with the SI group having71% female and 29% male (as compared to MACC with 60% female and 40% male) (TCC, 2006). Using ANOVA in SPSS, F (1, .37) = 1.57, p = .20, showing that the two groups did not differ significantly by gender. On enrollment status, the non-SI group had 47.5% part-time students (<12 credits) and 52.5% full-time. The SI group had 45.7% part-time students and 54.3% full time. Using ANOVA in SPSS, F (1, .02) = .10, p = .76, showing that the two groups were not significantly different in their enrollment status. The MACC overall student population has a higher percentage of part-time students (68.9%) than those students in the research study (TCC).

Work

In the last demographic variable of work, the non-SI and SI groups were again comparable. Figure 3 shows a clustered bar graph comparing the non-SI and SI groups' work hours. The largest category of work status was 32+ hours per week. Using ANOVA to compare the means of the two groups in work status, $F(1, .26) = .22, p = .64$, showing that the amount of time that students were employed did not differ significantly between the two groups. MACC does not collect data on student's time at work, so the researcher was not able to identify if these students were typical of other MACC students.

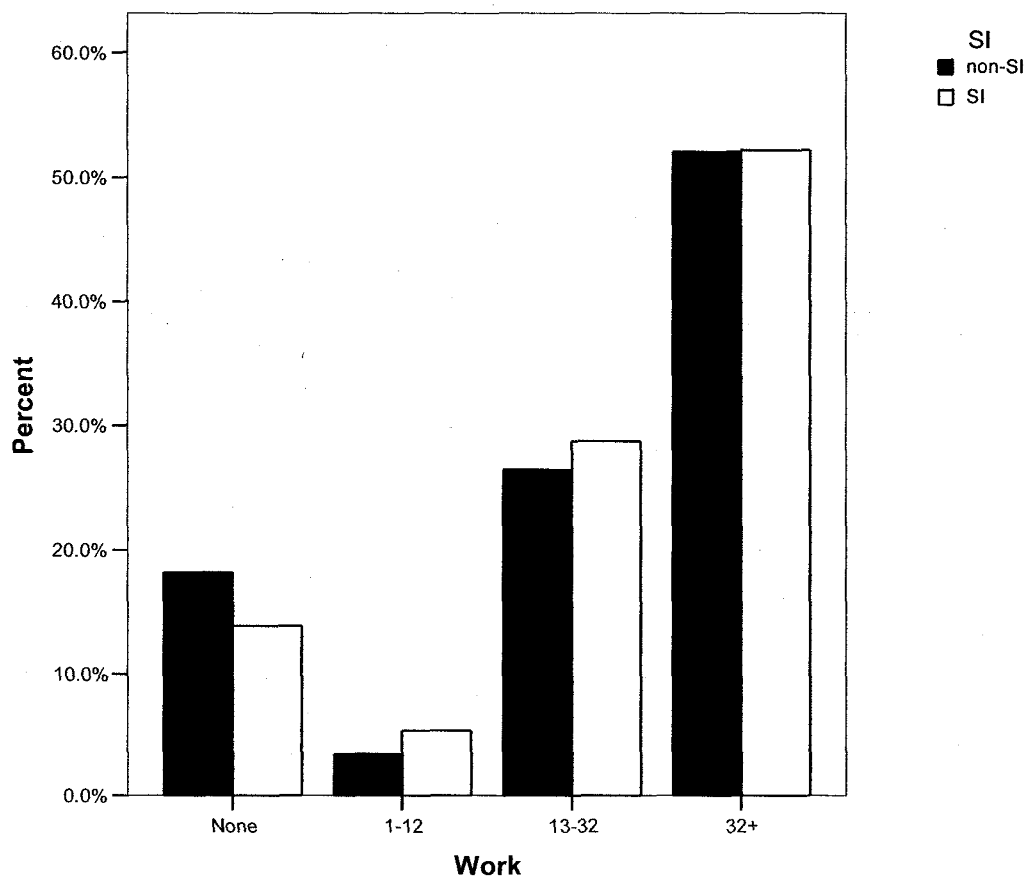

Figure 3: Comparison of non-SI and SI in work hours per week

Research Questions

The research questions for this program evaluation followed Patton's Utilization-Focused-Evaluation (UFE) model (Patton, 1997). This model follows a chain of objectives where accomplishing the first objective or goal makes the accomplishing of the second goal possible which in turn makes accomplishing the third goal possible. First, the implementation-level goal was associated with implementing the supplemental instruction program as it was designed in the Title III grant by Mid-Atlantic Community College. Second, the intermediate level goal was set to determine the success of the students resulting from providing the supplemental instruction program. Third, the long-range or ultimate goal was to find out how the SI and non-SI students ranked in metacognitive and study skills which would impact their future courses. The three research questions reflect these goals.

Research Question 1

Has the supplemental instruction program been implemented at MACC as designed in the Title III grant proposal?

A documents review, faculty interviews, and student focus groups were used to investigate the first research question. The Title III grant, the MACC Learning Assistance website, and the SI Leader time logs were reviewed to determine whether or not the SI program was implemented as designed. As questions arose which were not answered in existing documentation, the researcher contacted the Title III coordinator for clarification. The researcher interviewed faculty individually in summer 2007, and their responses were transcribed, then coded for themes. The researcher also acted as facilitator in student focus groups in spring 2007 with a co-facilitator who later assisted in transcribing the responses and coding them for themes.

Documents Review

Faculty development. According to the Title III grant document, faculty development for math faculty was to take place in the fall semester of 2002 and continue throughout the term of the grant in each of the summers of 2003-2007 (TCC, 2000). However, in speaking with the Title III coordinator, only one professional development workshop for faculty was ever held. That workshop was in the summer of 2003 (S. R. Harrell, personal communication, May 15, 2007).

Training for tutors. The Title III grant document also called for a total of 25 tutors for developmental math to be trained in the supplemental instruction model (TCC, 2000). This quantity of tutors was never achieved. By spring 2007, there were 3 SI Leaders in developmental math at the Chelsea campus, 2 at the Northland campus, 3 at the Portville campus, and 4 at Beachside campus yielding a total of 12 tutors as opposed to the 25 required to be in compliance with the grant (S. R. Harrell, personal communication, May 15, 2007).

Website. The Title III grant proposal called for an interactive project website. As part of the funding for the grant, a media specialist was hired to develop this website. The purpose of the website was to provide on-line supplemental instruction for face-to-face class students as well as those military students who might be transferred out of the area (TCC, 2000). The website was to be constructed to allow opportunities for students to interact with instructors and other students through an electronic help desk. Also, students were to have access to a web board for asynchronous assistance from tutors, instructors, and fellow students (TCC). The researcher visited this website during May 2007 and September 2007 with no change seen between the two viewings. Located at http://www.tcc.edu//students/academicdevelopment/index.htm this website listed the locations and phone numbers for the learning assistance facilities for the four campuses of MACC. Each of these facilities had a brief description in a sub-menu accessed from the main site. Each of the four campus websites had a link to supplemental instruction. This link took the researcher to a page with a brief description of supplemental instruction. There was no electronic help desk on the website; neither was there a web board for asynchronous assistance. The resulting website, therefore, was a directory of location information for assistance on the campuses, thus not meeting the description of the website in the grant.

SI Leader time logs. Each of the SI Leaders kept a time log separating their time into eight categories: 1) in class observation, 2) in class assistance, 3) out of class tutoring a workshop of MTH 3 students, 4) out of class individual tutoring of MTH 3 students, 5) team planning with the instructor, 6) training, 7) record maintenance, and 8) other – used for developing materials for tutoring. The Title III coordinator provided a set of semester time logs for the five SI Leaders who worked in spring 2007 with the MTH 3 classes of the study. The figures in Table 3 are statistics based on the total number of hours that the SI Leaders allotted in each category during the semester.

Table 3

Time Spent on Activities for SI Leaders in MTH 3, Spring 2007 (N = 5)

	M	Median	*SD*	Min	Max	Sum
Observe	12.52	.00	17.15	.00	31.90	62.60
Assist	43.06	32.50	33.40	16.40	101.50	215.30
Workshop	64.22	37.00	59.24	17.20	165.90	321.10
Individual	2.20	.00	3.03	.00	6.00	11.00
Planning	0.26	.00	.58	.00	1.30	1.30
Training	.00	.00	.00	.00	.00	.00
Records	2.30	2.50	2.42	.00	6.10	11.50
Other	17.72	14.00	24.02	.00	59.00	88.60

These time logs showed the distribution of the SI Leaders work time. The first use of time was that the sum of hours in classroom Observation and Assistance, 62.6 and 215.3 respectively, showed that the SI Leaders were attending the classes and assisting the students which was as the program was designed (TCC, 2000). The second use was that the overwhelming majority of time used in tutoring sessions was in a workshop format with 2 or more students (321.1 hours) rather than tutoring the students individually (11.0 hours) which again followed the program design. The third use of time was that the SI Leaders were planning their sessions as reflected by the "other" category with 88.6 hours which again followed the program design (TCC). The total planning time between SI Leaders and instructors was only 1.3 hours, and the total training time was 0 hours, each was much less than for which the program was designed. Each new SI Leader was supposed to receive training at the beginning of the semester, and each returning SI Leader was to receive training in at least one refresher workshop each semester. A MACC adjunct faculty member was trained by the University of Missouri at Kansas City to be the SI Leader Trainer for the MACC program, but after the beginning of the grant in 2002, she had conducted only a total of five training workshops by 2007 (S. R. Harrell, personal communication, May 15, 2007). Therefore, the training provided to the SI Leaders did not meet the description in the Title III grant.

Faculty Interviews

Faculty interviews were conducted in the summer of 2007 with the five faculty members who taught the six sections of MTH 3 in the SI group using the Faculty Interview Protocol (Appendix B). Two of the instructors were male and three were female, and two were full-time and three were adjunct. All were experienced in teaching

MTH 3 with the years of experience ranging from 5 to 37. The instructors were interviewed by the researcher who took notes and recorded the interview on a mini-recorder. The researcher transcribed the interviews into a table. The co-facilitator and the researcher independently analyzed the responses for codes, and then they compared their results in order to perform member checking (Boyatzis, 1998). The resulting codes with supporting themes are listed below:

Emphathetic. Faculty sought out the concerns of the SI Leaders about the students in the sessions and adjusted their teaching to account for these concerns. Faculty were also concerned about student progress. One professor stated, "The SI Leader could give me the student perspective and really helped me to learn what the student concerns were. I want my students to pass this class and get on to their college transfer classes, and the SI Leader is helping me to do a better job in helping the students." Another faculty commented, "Students will ask the SI Leader questions and tell them things they won't tell me. The SI Leader shares those with me, and I can adjust my teaching to accommodate for those concerns."

Collaborative. Faculty adapted their teaching practices to include collaborative learning, and they learned to be collaborative with the SI Leader. One faculty member commented, "I tried using collaborative learning and was impressed with how well the students could help each other (with some guidance from me). I used it more and more when I knew the students were faced with a difficult topic." Faculty also felt that student collaboration with the SI Leader made the difference in student pass rates. The following comment is typical of what all the faculty said, "SI has helped students to pass who otherwise would have just withdrawn from the class in frustration."

Reintegration. Faculty were able to adopt and use new styles of teaching. One faculty member commented, "Having the SI Leader in the class helped me to stop lecturing and give the students problems in class. My SI (Leader) and I would walk around the class and help the students. I found out that many students who had questions could work them out for themselves with some guidance from us." This comment showed that faculty changed their methods to more active learning according to student needs. Faculty also connected the new information from the SI Leaders with their prior knowledge. One faculty member stated, "The SI Leader got questions from the students that I guess they were afraid (or embarrassed) to ask me. The feedback from the SI Leader to me helped me to come back to class and do a better job of explaining that topic of concern."

Program concerns. Faculty stated that the SI program should be continued and expanded in developmental math. One faculty member stated, "I had a student that had failed Math 3 twice. She was convinced she could not pas the class. I assured her that if she attended SI sessions every week and completed all of her homework that she would improve her performance. She attended EVERY SI session, connected with the SI Leader and successfully completed the course." Faculty saw the importance of the SI sessions, and they would like to require student attendance at these sessions. Faculty needed to receive more professional development training in the SI model and in learning theories. A faculty member commented, "I heard there was a faculty seminar the first summer of the program and how great it was. I wanted to attend the next summer, but there were no more faculty seminars."

Student Focus Groups

Student focus groups were held with students from each of the supplemental instruction sections from MTH 3 in spring 2007. Ten students from each SI class of MTH 3 were randomly selected and sent invitations to attend discussion groups. The instructors were asked to distribute the invitations to the students. These groups were held at a time immediately before or after the students' math class to serve as a convenience for attendance, and refreshments were provided for the students. The focus group at the Chelsea campus was scheduled, and the researcher began the focus group only to find that supplemental instruction was not being performed for that particular class. The student who was hired to serve as the SI Leader had not ever attended the class, and the students did not know what supplemental instruction was. This result led to disbanding the focus group, and the Chelsea class was eliminated from the study altogether.

The researcher, serving as facilitator, conducted five focus groups with the SI classes at the Northland, Portville, and Beachside campuses. Responses from the students were recorded on flip charts and on a mini-tape recorder. The facilitator and co-facilitator transcribed the tapes, individually identified codes and then themes from the transcription, and then compared their results as a member check (Boyatzis, 1998). These themes are listed below:

Helpful. Students had a positive view of supplemental instruction. In every focus group session two or more students used the word "helpful" when describing the SI program. They stated that having an SI Leader made the difference in their success. Students also stated that having the SI Leader in the classroom and in sessions created improved learning for them. A comment with which students immediately agreed was, "With the SI Leader I work faster with less stress."

Persistence. Students stated that they got their questions answered by the SI Leader. One student stated, "I have so many questions that I'm embarrassed to stop the whole class to ask them. The SI Leader makes sure I know how everything works before I leave the SI session." They were willing to continue working because of the SI Leader. Students also stated that they continued in the class and would be ultimately successful because of the SI model. A student stated, "I can think about math better now – I know how to keep going."

Collaboration. Students stated that they preferred to work in collaborative groups in the classroom and in the SI session. One student commented, "It is faster to learn when working in groups. We ask questions of the group rather than stopping the teacher to ask." They also stated that the collaborative atmosphere in the classroom led them to be collaborative outside the class and sessions. A student commented, "I got the phone numbers of the people in my group. I call them and they call me. We're able to work math over the phone or sometimes we meet at the library on weekends."

Program Concerns. Students wanted the SI Leader and teacher to use the same approaches in problem solving. A typical comment from a student on this topic was, "It really messes me up when the SI Leader tries to show us a way to work the problem that is different from the teacher. I'm too new at this. I just need one way that works." They also stated that the SI program needed to be continued with more sessions available for each class. One student commented, "This is my third try to pass Math 3. I'm doing great, and I know that having the SI Leader is why. I hope they never get rid of this program."

Conclusion

Therefore, the results for research question 1 were varied and indicated both compliance and non-compliance with the implementation of the SI program as it was designed in the Title III document. Training for SI Leaders and faculty was limited and much less than was described in the Title III document. The website design also did not accomplish what was listed in the Title III document with no learning assistance being provided through the website. The time logs of the SI Leaders did show that they were attending the classes and providing assistance in the form of workshops for the students, although their planning with the faculty member was limited. Both the faculty interviews and student focus groups showed great support for the supplemental instruction program with both wanting the program to continue and/or be expanded. In summary, the SI program was not implemented as designed regarding faculty and SI Leader training but was implemented as designed in the SI Leader performance in and out of the classroom.

Research Question 2

What was the impact of supplemental instruction on the course completion rates, persistence rates and learning gains for SI developmental mathematics students as compared to those for non-SI developmental math students?

The purpose of the second research question was to investigate the impact of the SI program on student success. First, an independent samples t-test was run on the pre-test (Algebra I Assessment) results for the research (SI) group and control (non-SI group) to establish that the two groups were equivalent in algebra knowledge at the beginning of the study. After this equivalence was established, the components of the research question were investigated. For this investigation, course completion rates were computed from the Student Information System (SIS) using final letter grades reported in May 2007. Persistence rates were also computed from information from the SIS in where students re-enrolling for the fall semester were counted as persisting when they were enrolled on September 15, 2007.

Learning gains were originally to be computed by comparing pre-test and post-test results; however, the researcher received a limited number of post-test results and irregular scores on these. Instead, final numerical grades were compared between the SI and non-SI groups using the pre-test score as covariate to control for original knowledge in algebra.

Equivalence of Groups

The MTH 3 classes to be included in the study were randomly selected from the classes having SI Leaders (research group) and those classes who did not have an SI Leader (control group). Of the 20 classes selected, only 6 of the SI classes participated in the study and 7 of the non-SI classes participated. An Algebra I Assessment test (Appendix D) was administered to those classes in the first week of class in January 2007. The instructors of those classes sent the completed tests to the researcher to score. The researcher provided the instructors with the student results using the student ID number as the identifier.

The researcher compared the Algebra I Assessment test results of the two groups using an independent samples t-test. This test showed no significant difference between the two groups on the Algebra I Assessment test. The mean for the 107 students in the SI group was 37.09 ($SD = 16.63$) while the mean for the 103 students in the non-SI group was 36.08 ($SD = 15.62$). This difference was not significant ($t = 0.46$, $df = 208$, $p = .65$).

This similarity in pre-test results along with the similar demographics of the two groups established that the groups were equivalent at the beginning of the study. Additionally, an examination of the pre-test results of the two groups showed that both groups had pre-test results that were approximately normal as shown in figures 4 and 5. Establishing the normality of the pre-test results gave the researcher the option to use parametric statistics for the remainder of the study. Based on the equivalence of the control and research groups, the researcher then investigated the course completion rates of the two groups.

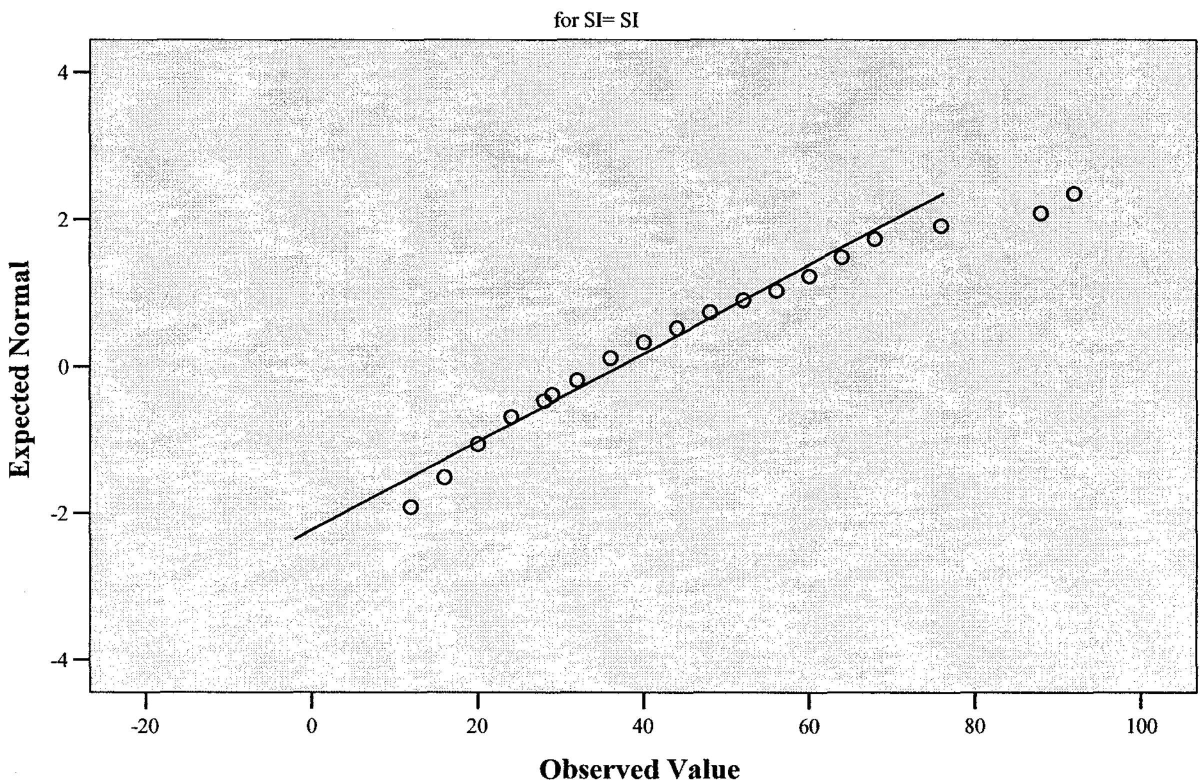

Figure 4: Comparison of SI pre-test results to normal

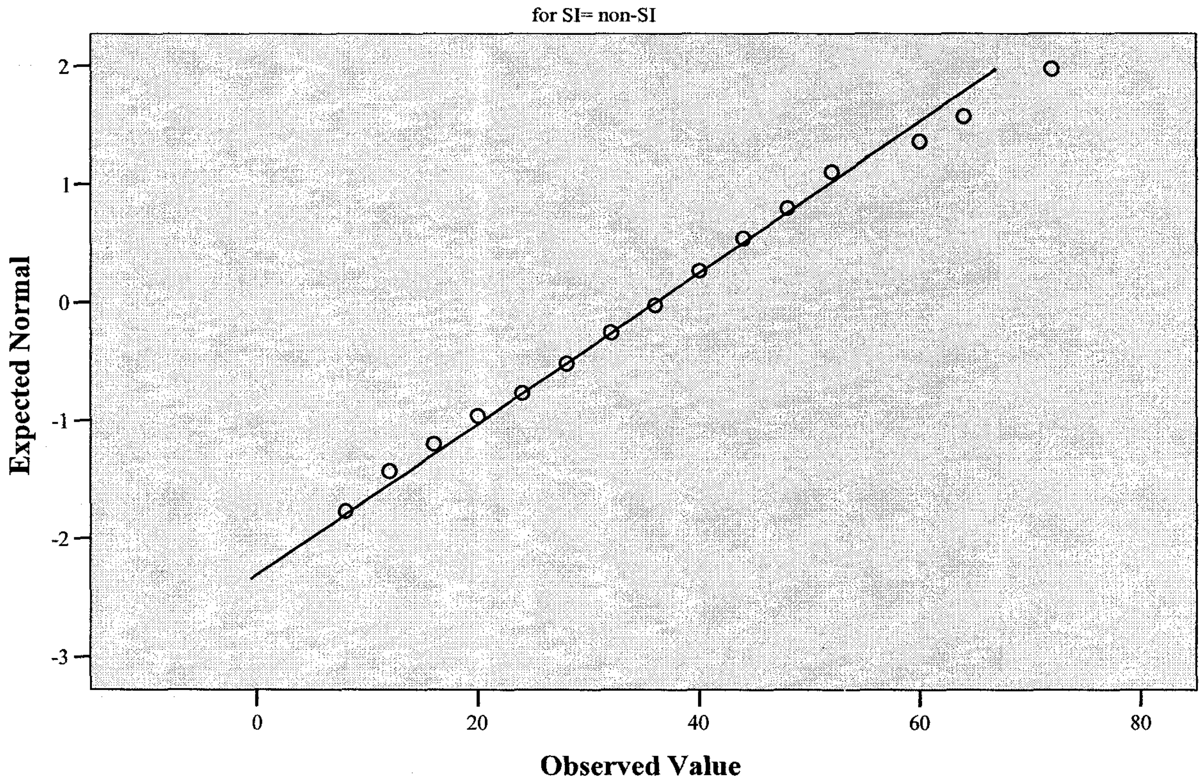

Figure 5: Comparison of non-SI pre-test results to normal

Course Completion Rates

Students who received a grade of Satisfactory (S) for the MTH 3 class were counted as completing the course. Those who received a grade of Repeat (R), Unsatisfactory (U), or Withdrawal (W) were counted as non-completers. Table 4 shows a comparison of completion rates for students in the SI and non-SI sections. The completion rate in the SI classes was 53.6% compared to the completion rate in the non-SI classes of 43.7%. An ANOVA was used to determine if there was a significant difference between the completion (success) rates of the two groups. This test showed $F(1, .73) = 2.93$, $p = .08$. While p is not less than .05, this result showed a near-significance, and given a larger sample size would probably drop below the .05

significance level (Thorndike & Dinnel, 2001). Added to the 10.1% higher success rate in the SI groups, this statistic can be interpreted as representing a notable difference in the completion rates, with the SI group having the better completion rate.

Table 4

Comparison of Completion Rates in SI and non-SI Classes

SI		Frequency	Percent
Non-SI	Pass	69	43.7
	Failure	89	56.3
	Total	158	100
SI	Pass	74	53.6
	Failure	64	46.4
	Total	138	100

Persistence Rates

Students' registration for fall semester 2007 was checked in the Student Information System on or about September 15, 2007. Students from the 13 classes involved in the study were counted as persisting if they were registered for classes at MACC at that time. Students who were not registered in the fall were counted as not persisting. Of the students in SI sections of MTH 3 in the study, 65.2% persisted in the fall semester compared to 55.1% of the non-SI students who persisted. An ANOVA revealed $F(1, .76) = 3.17$ with $p = .07$. This statistic again approaches statistical significance and coupled with the 10.1% higher persistence rate of the SI group students indicated a notable difference in persistence.

Learning Gains

The design of the study was based on the students in the classes taking a post-test using the same Algebra I Assessment test. The comparison of the pre/post-test was to reveal the learning gains of the students. Unfortunately, only 120 of the 296 students took the post-test. With the pre-test, students were anxious to find out their results because with a score of 75% or better they could be exempted from taking the developmental math course. No such incentive existed for taking the post-test, and the overall average was a 60.6 with a *SD* of 20.6. This *SD* was even larger than on the pre-test ($M = 36.6$, $SD = 16.1$). Faculty members also reported that students did not take the post-test as a serious instrument. These results could limit the reliability of the post-test results.

An exploration of the normality of the post-test results revealed that they were approximately normal. Using SPSS to explore the descriptive statistics and accessing the normality plots, both the SI ($p = .036$, $n = 46$) and non-SI groups ($p = .015$, $n = 74$) did not differ significantly from the normal. An independent samples t-test showed no significant difference between the post-tests of the SI and non-SI groups ($p = .644$). Due to the unreliability of the post-test result, however, the researcher contacted the instructors of the research sections and obtained all students final numerical grades.

These final grades were then used to determine the differences in achievement between the SI and non-SI sections. The data were split between SI and non-SI sections and the descriptive statistics were examined. The mean of the non-SI group final grade was 54.0% ($SD = 35.2$) and the mean of SI group was much higher at 67.2% ($SD = 28.0$)

as shown in table 5. This 13% larger mean in final grade seemed to indicate that the SI group had a greater level of achievement. Next, an analysis of variance was used to determine if there was a significant difference between the final grades of the SI and non-SI groups.

Table 5

Comparison of Descriptive Statistics for Final Grade for SI and non-SI Groups

SI		*N*	*M*	*SD*
Non-SI	Final Grade	158	54.03	35.17
SI	Final Grade	138	67.23	28.05

In the ANOVA, Table 6 shows that the difference in final grade between the SI and non-SI groups is significant with $F(1, 12{,}847.67) = 12.51$, $p = .00$. Using the pre-test as a covariate to control for the initial algebra knowledge of the students, an analysis of covariance was used to further examine the difference in final grade. Table 7 shows that the difference between the two groups is significant when controlling for the pre-test with $F(1, 7078.40) = 7.30$, $p = .007$. Thus, given the equivalence in algebra knowledge of the SI and non-SI groups at the beginning of the study, the significant difference in knowledge at the end of the semester is an indicator of the success of the SI model.

Table 6

ANOVA Comparing the Mean Final Grade of SI and non-SI Groups

	SS	*df*	*MS*	*F*	*p*
Between Groups	13847.67	1	12847.67	12.51	.000
Within Groups	301994.48	294	1027.19		
Total	314842.15	295			

Table 7

Comparison of Final Grades When Controlling for Pre-test Score

Source	Type III *SS*	*df*	*MS*	*F*	*p*
Corrected Model	23281.50[a]	2	11640.75	12.01	.000
Intercept	66927.39	1	66927.39	69.06	.000
Pretest	15517.71	1	15517.71	16.01	.000
Si	7078.40	1	7078.40	7.30	.007
Error	200603.78	207	969.10		
Total	1086479.00	210			
Corrected Total	223885.28	209			

a. R^2 = .104 (Adjusted R^2 = .095)

Conclusion

The second research question sought to determine the effect of the supplemental instruction program on the students in their course completion, persistence, and learning gains. Statistics show a marginally significant difference between the SI and non-SI groups in their course completion and persistence with the SI group being more successful in both measures. The poor post-test procedure made the results invalid for the purposes of this study to determine learning gains. The final grade measure, however, demonstrated that the SI group did significantly better than the non-SI group even when controlling for the pre-test score. In summary, the researcher found that the SI groups did have higher course completion, persistence, and learning gains which met the intermediate-level goal of Patton's utilization-focused evaluation for successes (Patton, 1997).

Research Question 3

What metacognitive and study skills do students have that will assist them in being successful in future courses and is there a difference between the SI and non-SI groups?

The third research question sought to determine the long-term effect of the SI program on student success. The researcher administered the Motivated Strategies for Learning Questionnaire (MSLQ) at the end of the course to assess the metacognitive and study skills of the students in the research study. The nine scales of the MSLQ (Appendix F) used in this study came from the learning strategies section and were divided into two main groups: 1) Cognitive and Metacognitive Strategies and 2) Resource Management Strategies. Students were asked to rate each item on a Likert scale from 7 (very true to you) to 1 (not at all true to you). The ratings on the items in each of the nine scales were then averaged to produce a score for that scale. Each of the nine scales was examined with an ANOVA comparing the SI and non-SI groups.

Cognitive and Metacognitive Strategies

Rehearsal. Four items in the MSLQ (numbers 39, 46, 59, and 72) assessed the learning strategy of rehearsal. Rehearsal strategies involve reciting or naming items from a list and involve the working memory rather than the long-term memory (Pintrich, et al., 1991). One of the items for this scale was "I make lists of important terms for this course and memorize the lists." There was no significant difference between the SI and non-SI groups with $F(1,2.69) = 1.64$, $p = .20$ on the learning strategy of rehearsal. This results indicates that the two groups had no significant difference between their level or rehearsal strategy.

Elaboration. Six items in the MSLQ (numbers 53, 62, 64, 67, 69, and 81) assessed the learning strategy of elaboration. Elaboration strategies help students store information into long-term memory and include summarizing and connecting new information with prior knowledge (Pintrich, et al., 1991). One of the items for this scale was "When reading for this class, I try to relate the material to what I already know." There was no significant difference between the SI and non-SI groups with $F(1, 2.06) = 1.01$, $p = .32$ on the learning strategy of elaboration. This result indicates that the two groups were not significantly different in the way they connected new information with prior knowledge.

Organization. Four items in the MSLQ (numbers 32, 42, 49, and 63) assessed the learning strategy of organization. Organization strategies help the learner select appropriate information and also construct connections among the information to be learned (Pintrich, et al., 1991). One of the items for this scale was "When I study for this course, I go over my class notes and make an outline of important concepts." The findings here were marginally significant with $F(1, 6.21) = 3.56, p = .06$. The SI group had $M = 4.35$, $SD = 1.17$, and the non-SI group had $M = 3.85$, $SD = 1.45$. Thus, the SI group demonstrated the higher level of organization skill.

Critical thinking. Five items in the MSLQ (numbers 38, 47, 51, 66, 71) assessed the student's ability to think critically. Critical thinking refers to the degree to which students report applying previous knowledge to new situations in order to solve problems (Pintrich, et al., 1991). One of the items for this scale was "I treat the course material as a starting point and try to develop my own ideas about it." There was no significant difference between the SI and non-SI groups with $F(1, .085) = .04, p = .84$ on the learning strategy of critical thinking. This results reveals that there was no significant difference in the level with which the groups applied prior knowledge to solve new problems.

Metacognitive self-regulation. Twelve items in the MSLQ (numbers 33(reversed), 36, 41, 44, 54, 55, 56, 57(reversed), 61, 76, 78, and 79) assessed the learning strategy of metacognitive self-regulation. Metacognitive self-regulation refers to the awareness and control of cognition (Pintrich, et al., 1991). One of the items for this scale was "I ask myself questions to make sure I understand the material I have been studying in this class." Several items in this section were reversed, such as "During class time I often miss important points because I'm thinking of other things." On these items the researcher had to subtract each item score from 8 to reverse the scoring. There was no significant difference between the SI and non-SI groups with $F(1, .02) = .02, p = .89$ on the learning strategy of metacognitive self-regulation. This result shows that there is no significant difference between the two groups in their awareness and control of cognition.

Resource Management Strategies

Time and study environment. Eight items in the MSLQ (numbers 35, 43, 52 (reversed), 65, 70, 73, 77 (reversed), and 80 (reversed)) assessed the learning strategy of time and study environment. Time and study environment include scheduling, planning, and managing one's study time (Pintrich et al., 1991). One of the items for this scale was "I usually study in a place where I can concentrate on my course work." A reversed item was "I find it hard to stick to a study schedule." There was no significant difference between the SI and non-SI groups with $F(1, .44) = .37$, $p = .54$ on the resource management strategy of time and study environment. This result reveals that there is no significant difference between the treatment and control groups in their control of their time and study environment.

Effort regulation. Four items in the MSLQ (numbers 37 (reversed), 48, 60 (reversed), and 74) assessed effort regulation. Effort regulation includes the student's self-regulation to control their effort and attention in the face of distractions and uninteresting tasks (Pintrich, et al., 1991). One of the items for this scale was "I work hard to do well in this class even if I don't like what we are doing." A reversed item was "When course work is difficult, I give up or only study the easy parts." There was no significant difference between the SI and non-SI groups with $F(1, .22) = .16$, $p = .69$. It is worthwhile to note that both groups had a high mean in this area: for the SI classes, M = 5.60 with SD = 1.14, and for the non-SI classes, M = 5.50, with SD = 1.17 indicating that both groups viewed their amount of effort for this developmental math class as high.

Peer learning. Three items on the MSLQ (numbers 34, 45, and 50) assessed peer learning. Peer learning is collaborating with one's peers to help a learner clarify course material and reach insights one may not have attained on one's own (Pintrich, et al., 1991). One of the items in this scale was "When studying for this course, I often try to explain the material to a classmate or a friend." There was no significant difference between the SI and non-SI classes on this item, but the p value was much smaller with $F(1, 3.06) = 1.16, p = .29$ on the resource management strategy of peer learning. This result reveals that there is no significant difference in the way that students in both groups rely on peers to assist them in their learning.

Help-seeking. Four items on the MSLQ (numbers 40 (reversed), 58, 68, and 75) assessed help-seeking. Help-seeking includes identifying a peer or instructor who can offer assistance when the student realizes he does not know something (Pintrich, et al., 1991). One of the items in this scale was "I ask the instructor to clarify concepts I don't understand well." A reversed item on this scale was "Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone." The difference between the SI and non-SI groups was marginally significant with $F(1, 4.72) = 3.07, p = .08$. The mean of the SI group was higher with $M = 4.43$, $SD = 1.13$, and the mean of the non-SI group was $M = 3.99$, $SD = 1.33$ indicating a higher rate of help-seeking on the part of the SI group.

Conclusion

The MSLQ is designed to determine the cognitive and metacognitive strategies and resource management strategies of students. On seven of the nine scales, no significant difference was found between the SI and non-SI groups. However, both organization and help-seeking both showed a near significance. SI Leaders were instructed to assist students with their organization skills, encourage students to look in their own notes for answers to questions, and to seek help from other students and the Leaders themselves. It is notable that these strategies were shown in the MSLQ instrument results. In summary, it does not appear that the SI program met its long-range goal of assisting the students to be successful in the future with their learning strategies.

Summary and Conclusion

Conclusions drawn from an analysis of the results of this study are delineated below. While there were areas of near statistical significance, other areas were not shown to be significantly different.

1. Demographic data from the SI and non-SI groups showed that they were approximately the same in age, race, gender, employment status, and enrollment status.
2. On work status, the groups were again equivalent with 50% of both groups working the equivalent of a full-time job.
3. Faculty development was not carried out as the Title III grant was designed. Only one of five planned faculty development seminars was held.
4. Neither the number of tutors designed in the Title III grant nor the level of their training was ever met. Instead of having periodic training sessions throughout the semesters, many SI Leaders had one or no training sessions.
5. The SI website was in form only, and it did not offer any synchronous or asynchronous assistance to students.
6. The SI Leader time logs did demonstrate that they were attending the classes, offering assistance in class, and offering workshops outside of the classroom as

the Title III grant was designed. However, the Leaders did not have the planning time with the faculty as was required in the grant.

7. Faculty interviews showed that the faculty desired more SI Leaders and sections, and that the faculty were using the SI Leaders as the grant intended. However, the focus of the faculty was on the immediate learning of course material rather than on teaching learning strategies that would benefit students beyond the course.
8. Student focus groups showed support for the SI program and supported faculty comments that many students needed the SI program in order to be successful. Students also asked for additional SI sections and coordination between the faculty and SI Leader. It was notable that the learning strategies that the students described using were the same strategies that were near statistical significance in the MSLQ instrument: organizing and collaborative learning.
9. The pre-test results for the SI and non-SI groups were not significantly different and approached the normal curve. This result, combined with the demographic similarity of the groups, established their equivalence at the beginning of the study.
10. Completion and persistence rates were 10.1% higher for the SI than non-SI groups. While the significance was near statistical significance, this difference in percentage makes the statistical significance notable.
11. Poor post-test procedures made the determination of learning gains by comparing the pre- and post-test impossible.

12. Final course grades showed a significant difference between the SI and non-SI groups with the SI group showing a higher average final grade even when controlling for the pre-test score.
13. The MSLQ results demonstrated a near significance in only two of the nine scales: Organization and Help-Seeking. This difference is understandable with the emphasis of the SI program on assisting the students to become more organized and encouraging them to seek help from each other and the SI Leader.

In Patton's utilization-focused evaluation framework (1997), the implementation, intermediate, and ultimate level goals were addressed by the three research questions. First, the implementation level goal was not met in three instances as demonstrated from the lack of training for the SI Leaders and faculty, the SI website, and lack of communication between the faculty and SI Leaders. One area that was implemented correctly was the interaction between the students and the SI Leaders. Second, the intermediate level goal was met as demonstrated by the higher levels of course completion, persistence, and learning gains by the SI group. Last, the ultimate level goal was not met as demonstrated by the lack of significant difference in the MSLQ scores between the SI and non-SI groups.

This chapter has described the data collection process, the method for identifying the two student groups, and the relevant demographic data for both groups. The findings of the study relevant to the three broad research questions of the program evaluation model of Patton have been presented along with conclusions drawn from the results. A discussion of the findings of the study and recommendations for further research will be presented in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a summary of the program evaluation and presents conclusions based on the findings. In addition, this chapter addresses limitations of the study and, when possible, how those limitations were lessened. This chapter also addresses implications of the findings for improving the application of supplemental instruction in developmental math in the community college in Virginia and recommendations for future research.

Summary

The purpose of this research study was to evaluate the program application of supplemental instruction to the developmental mathematics program at Mid-Atlantic Community College. The theoretical framework for this program evaluation used Patton's Utilization Focused Evaluation (UFE) model which based the research questions on the chain of objectives model. In the UFE model, after the first objective or goal is accomplished, then the second may be accomplished. Once the second objective is accomplished, then the third objective becomes possible. The first objective was the implementation-level goal of implementing of the supplemental instruction program as designed in the Title III grant. The second objective was the intermediate-level goal of impacting the course completion and persistence rates for students in the SI classes as compared to those in the non-SI classes. The final objective was the ultimate-level goal of bringing about a long-term impact on the metacognitive and study skills of the students in the SI classes as compared to those in the non-SI classes. Before performing this program evaluation, it was necessary to research the literature on developmental math and supplemental instruction.

The literature shows that while there is an increasing need for students who are skilled in science and math (Olstad & Beal, 1984; Borja, 2005), the United States is falling behind in the number of graduates who have those skills (Walters, 2005). In fact, students are arriving at colleges with deficient math skills (Waycaster, 2001) while businesses are expecting employees to have numerical and quantitative skills (Bracey, 2001). It is the role of the community college to increase the deficient math skills of these students.

The way that community colleges provide the remediation for these students is through developmental courses before they can enroll in college transfer math courses (Schults, 2001). They should be required to take developmental courses to increase those deficient skills (Boylan & Saxon, 1999), and they will probably not be successful in college without these skills (Cross, 1976). However, developmental math students have a tendency to remain disinterested and uninvolved in the class (Thomas & Higbee, 2000). It was for these reasons that Mid-Atlantic Community College was interested in increasing the success rates of students in their developmental math courses.

To increase success in developmental math, colleges use many forms of learning assistance. These forms are general purpose learning assistance centers (Stern, 2001), break-out sections for large classes (Spencer, 1992), peer tutoring (Xu, et al., 2001), and supplemental instruction (Burmeister, 1996). All of these forms are utilized by students who seek out help because they are having difficulty in their classes. In addition, supplemental instruction begins from the first day of a class and is used by all students in the class (Blanc, et al, 1983). This proactive method has a supplemental instructor leader (SI Leader) in the classroom who has successfully completed the class and conducts SI sessions outside of the class time (Blanc, et al.). In these sessions, the students are encouraged to answer their own questions with the support and guidance of the SI Leader. Students are encouraged to work collaboratively, both in and out of the classroom setting. This different kind of tutoring program has more desired outcomes than helping the students to be successful in the class.

The goals of SI are to increase the retention of the students (Wild & Ebbers, 2002), raise the level of student achievement (Congos & Schoeps, 1998), increase the student's level of satisfaction with the course (Stern, 2001), raise the attendance in the class (Boylan & Saxon, 1999), and increase the students' metacognitive and study skills (Boylan, 2002). Supplemental instruction was designed for high-risk courses that usually have a large class size (Blanc et al., 1983). While developmental math courses qualify as high-risk because of the students' low success rate, the class size is usually small (Waycaster, 2001). In addition, applying SI to developmental courses rather than college transfer is a different application of this new kind of tutoring method. Given these goals of SI and the unusual application of SI to developmental math, the Title III grant selected SI as its method to impact the developmental math students' success at Mid-Atlantic Community College.

Research Questions and Conclusions

Using Patton's Utilization-Focused Evaluation model (1997), the research questions were directed toward the implementation-level, mid-level, and ultimate level goals of the supplemental instruction program. Since these goals formed a chain of objectives where satisfaction of one goal depended on the satisfaction of the goals in the level before, the research questions took on a hierarchical framework.

Question 1 – Implementation of Supplemental Instruction

A documents review, faculty interviews, and student focus groups were used to investigate the first research question. The Title III grant proposal, the MACC Learning Assistance website, and the SI Leader time logs were reviewed to investigate if the program was implemented as designed. The researcher conducted faculty interviews individually with each of the faculty teaching the SI sections in spring 2007. The researcher also conducted a separate student focus group with each of the SI classes in the study in spring 2007.

Training

Training the SI Leaders and the faculty is a critical component for success of the SI model (Blanc et al., 1983). However, the researcher found that neither the faculty nor the SI Leaders had been trained at the level stated in the Title III grant document. Only one faculty seminar was conducted during the five year grant period, while the grant document specified five seminars spread over the summers of that same time. SI Leaders were to receive initial training and then periodic training throughout the semesters of their work. The SI Leader time logs revealed no training in the spring of 2007. A conversation with the Title III grant coordinator revealed that the SI Leaders' training was erratic with some SI Leaders receiving no training other than discussions with the coordinator, faculty, or other SI Leaders. Other SI Leaders did attend training seminars, but these were not regularly scheduled and did not support their training needs.

This lack of training may have hindered the ability of the faculty and SI Leaders to implement the SI program effectively. Boylan and Saxon (1999) stress the importance of training in order for tutoring to impact students' pass rates and retention. Congos and Stout (2001) proffer that SI Leaders must be trained in order to be effective. Burmeister (1996) found that a lack of consistent training of SI Leaders could cause an SI program to be ineffective. Tutors and faculty often make the mistake of working students' problems for them (Boylan & Saxon), and training in the SI method of having the students work collaboratively to find their own answers forces the students to become independent learners. Faculty even stated in interviews that they wanted more training in the SI model and learning theories.

Website

The Title III grant proposal called for an interactive project website providing opportunities for students to interact with faculty and other students through an electronic help desk. This website was not constructed as described in the grant. Although it provided a list of the math labs on the four campuses of MACC, none of these items were interactive. Constructing the site as stated in the grant would have been very difficult due to the expense and time commitment of having a math professional to constantly attend to the site. While SI Leaders are knowledgeable in the class material, one would not be able to answer the variety of questions with the depth required that might be asked on an open discussion board. However, a link to a Blackboard site where students could post questions and receive answers would have been an effective way to satisfy some of the requirements stated for the website.

Classroom and Session Implementation

Student focus groups, faculty interviews, and SI Leader time logs verified that the SI model was implemented in the classroom and SI sessions. Student focus groups revealed that SI Leaders assisted the students in their learning and persistence. Students stated that they preferred working collaboratively in the classroom and sessions revealing that SI Leaders and faculty were stressing collaborative learning. Faculty interviews also revealed that they had adapted their instructional practices to include collaborative learning. SI Leader time logs revealed that the majority of their time in assisting students was done in a workshop setting with two or more students. Commander et al. (1996) stressed the importance of group interaction using Tinto's model. In conducting the focus groups, the researcher found a feeling of camaraderie among the students who had been working collaboratively in the SI model. Congos (2002) found that the SI model met Chickering's seven principles for good practice in undergraduate education in the areas of cooperative and active learning. It appears that the implementation of the SI model in developmental math did stress collaborative learning.

Students in the focus groups voiced one area of concern in the implementation of the SI model: the students wanted the SI Leader to follow the same approaches in solving math problems as the instructor. This concern reveals two areas of difficulty in the application of the SI model. First, SI Leaders are involved in the classroom, even though they have already successfully completed the class, to allow them to form a bond with the students and to understand how the instructor is approaching the material of the class. If an SI Leader is not following the instructor's approach, then the Leader may confuse these novice math students. Second, SI Leaders are supposed to refer the students to their own notebooks and lead them in discussions to work through their problems and questions. If an SI Leader prompted the student response that he/she was not following the same approach as the faculty, then that SI Leader must not be following the tenet of having the students find their own solutions to the problems. That is, the SI Leader was working the problems instead of the students. Again, a lack of training may be at the root of this difficulty with the implementation of the SI model.

Overall, both faculty and student responses indicate a support of the SI program, and both would like the program to be retained and expanded. Students indicated that they would recommend the program to a family member enrolling at MACC in developmental math. Faculty indicated that having the SI Leader made them more empathetic and in touch with student concerns and problems which allowed them to adapt their teaching methods and integrate them into the classroom.

Question 2 – Impact of SI on Students

The mid-level goal in Patton's UFE model (1997) was to determine what impact the program was having on the students it served. The Title III program sought to improve the success and persistence rates of the students in the developmental math at Mid-Atlantic Community College. An Algebra I Assessment test served as the pre- and post-test; the Student Information System (SIS) provided information on pass rates and persistence of students; and faculty provided final numerical grades for the students. This part of the program assessment compared students in the SI classes (treatment group) with students in the non-SI classes (control group). Using ANOVA, the groups did not differ significantly in their age, race, gender, enrollment status, or hours of work.

Student Success

The Algebra I Assessment test was used as a pre-test to establish the equivalence of the two groups in their knowledge of algebra at the beginning of the spring 2007 semester. An independent samples t-test confirmed that there was no significant difference between the two groups on the Algebra I Assessment given in January 2007. Success in the course was defined as those students completing the course with a grade of Satisfactory (S). Non-completers were those students who received an R (repeat), U (unsatisfactory), or W (withdrawal).

A comparison of the treatment and control groups using ANOVA showed a near significant difference ($p = .08$) between the two groups. The SI classes had a completion rate of 53.6%, and the non-SI classes had a completion rate of 43.7%. This 10% higher completion rate, coupled with the p value, indicated a degree of success for the SI method. Thorndike and Dinnel (2001) state that increasing the sample size in a statistical test can yield a significant difference when the result with a smaller size was nearly significant.

Learning Gains

The original intent of this research study was to measure the learning gains of the students through a comparison of the pre- and post-test results. However, faculty reported that the students did not take the post-test seriously, and only 120 of the 296 students took the post-test. An independent samples t-test showed no significant difference between the post-test results of the treatment and control groups.

Given the unreliability of the post-test results, the researcher contacted the instructors for the thirteen classes in the two groups who provided the final numerical grades for the students. The researcher compared the final grades of the treatment and control groups using ANCOVA, with the pre-test grade as a covariate, and found a significant difference (p = .007) with the treatment group having a 13% higher average final grade. Some researchers claim that inherent motivation and prior knowledge account for the difference in success of SI students (Bowles & Jones, 2003/2004b; McCarthy et al., 1997). This claim is discounted in this research because the two groups 1) had no prior knowledge of SI or which sections would be assigned an SI Leader, 2) were equivalent in demographic characteristics, and 3) showed a significant difference in final grades even accounting for their prior algebra knowledge. Gattis (2002) is among the researchers who confirmed that SI students achieve higher average course grades, even when controlling for prior academic achievement.

Persistence

The researcher used the SIS on September 15, 2007, to find which students had persisted from the spring 2007 semester to the fall 2007 semester. An ANOVA determined that there was a near significant difference between the two groups (p = .07) with the SI groups having 10.1% higher persistence rate. Many researchers have found that supplemental instruction improves retention of students (Boylan & Saxon, 1999; Burmeister, 1996; Congos & Schoeps, 1998; Ogden et al., 2003; Ramirez, 1997; Weissman et al., 1997). This prior research, with the positive results of this study, confirm that using SI as a method of learning assistance does improve persistence of students. Burmeister even claimed that the cost of SI is returned to the college by the savings generated by retaining students. It is worth noting that students in the focus groups stated that supplemental instruction helped them to persist and be successful in the class.

Question 3 – Long-Term Effect on Students

The third question sought to determine the long-term effect of the SI program on student metacognitive and study skills. The researcher administered the Motivated Strategies for Learning Questionnaire (MSLQ) at the end of the spring 2007 semester to students in both groups of the research study. The nine scales of the MSLQ used in this study were divided into two main groups: 1) Cognitive and Metacognitive Strategies and 2) Resource Management Strategies. Students were asked to rate each item on a Likert scale from 7 (very true to you) to 1 (not at all true to you). The ratings on the items in each of the nine scales were then averaged to produce a score on that scale. Each of the nine scales was examined with an ANOVA comparing the SI and non-SI groups.

Cognitive and Metacognitive Strategies

The only strategy that showed a difference between the SI and non-SI groups was *organization.* Organization strategies help the learner select appropriate information and construct connections among the information to be learned (Pintrich, et al., 1991). The finding here was marginally significant ($p = .06$) with the SI group having a higher mean score. Skills that were stressed by SI Leaders in the sessions were organizing the student's notes, selecting key ideas, and outlining procedures. This emphasis may be reason that the SI classes scored higher in this area.

Even though SI aims to improve metacognitive self-regulation (the awareness and control of cognition) (Blanc et al., 1983), the groups were not significantly different in this area ($p = .89$). Pintrich et al. (1993) further define this area to include planning (setting goals), monitoring (of one's comprehension), and regulating (adjusting depending on the task). Both the SI and non-SI groups rate themselves above average: SI had M = 4.47 (SD = .70) and non-SI had M = 4.44 (SD = 1.06). The lack of thorough training of the SI Leaders could be impacting the students in this area. If students were being challenged to answer their own questions in the SI sessions, then their metacognitive strategies should improve.

Resource Management Strategies

The only resource management strategy that showed a difference between the SI and non-SI groups was *help-seeking.* Help-seeking includes identifying a peer or instructor who can offer assistance when the student realizes he does not know something (Pintrich, et al., 1991). The difference between the SI and non-SI groups was marginally significant (p = .08) with the SI group having the higher mean score. This finding was consistent with the philosophy of the SI program which encourages students to seek help from the SI Leader. Students in the focus groups stated that they sought help from the SI Leader because their learning was improved, and they could work faster with less stress.

The strategy of *peer learning* did not show a significant difference between the two groups (p = .29). This result was unexpected given the emphasis on collaborative learning in the SI classes and sessions. The averages were also not very high in this strategy with the SI group having M = 3.22 (SD = 1.56) and the non-SI group having M = 2.86 (SD = 1.69). The student focus groups stated that collaborative learning was important to them, but the students who spoke out in the focus groups might be those who would more likely seek out collaborative learning on their own. This result also causes the researcher to question the training of the faculty and SI Leaders in the use of collaborative learning.

SI Program

In Patton's UFE framework (1997), the implementation, intermediate, and ultimate level goals were addressed by the three research questions. First, the implementation level goal was not met in three instances as demonstrated the lack of training for the faculty and SI Leaders, the SI website, and lack of uniformity between the faculty and SI Leaders. The SI Leaders did implement their interaction with the students correctly. The intermediate level goal was met as demonstrated by the higher levels of course completion, persistence, and learning gains by the SI group. The ultimate level goal was not met as demonstrated by the lack of significant difference in the MSLQ scores between the SI and non-SI groups.

Limitations

This research was performed to evaluate the supplemental instruction program at MACC. Threats to the validity, both external and internal, were considered and controlled as much as possible. As a research study, it was important to have external validity in order to be able to generalize the results to a population (Orcher, 2005). Internal validity was important because the researcher needed to be confident that the differences observed in a sample resulted from the treatment, in this case supplemental instruction. Each of the threats in this study was considered below.

Generalizability

This study was performed at all four campuses of a multi-campus community college which had both urban and suburban settings. The results might not be generalizable to other community colleges or other institutions of higher education. Developmental math students also have unique characteristics and might be different at other community colleges or universities. This threat to external validity was lessened by the presentation of statistics on the demographics of the students and their pre-test scores. These statistics allowed other colleges to compare their college populations to the subjects in this study and determine if the program might produce the same results in their populations.

Self-selection of Subjects

Another threat to external and internal validity was the self-selection of the subjects into the two groups (SI versus non-SI). Randomly selecting courses across all four campuses and using both night and day classes reduced this bias. When they registered, students also did not know about SI or which sections would have an SI Leader. A comparison of the pre-tests scores for the two groups established their equivalence at the beginning of the study in terms of prior algebra achievement.

Attrition

As Waycaster (2001) reported, attrition was a threat to internal validity in developmental mathematics courses. Also, differential attrition may be a problem if one group has a significantly higher withdrawal rate than the other group. The researcher looked for differences in withdrawal rates in the two groups. The SI group had a withdrawal rate of 7.97% compared to the non-SI group which had a withdrawal rate of 20.51%.

Diffusion of Treatment

Diffusion of treatment could be a threat to internal validity because members of the control group could voluntarily attend SI sessions as much (or more) than students in the treatment group. While it is unlikely that all the members of the control group would elect to attend as much as the treatment group, it was a possibility. Attendance was taken in the SI sessions, and none of the non-SI students were reported as attending SI sessions.

Treatment Fidelity

Treatment fidelity was also a possible threat to the internal validity of this study. Instructors, who have used an SI leader in the past but who do not have an SI leader this semester, may have adopted teaching methods that would improve their students learning in an amount comparable to those in the SI sections. On the other hand, instructors may have an SI leader in their classrooms that they are not using to full effect, and thus they would lessen the positive effect of having that SI leader.

Instructor-made Test

An instructor-made test such as the Algebra I Assessment was a threat to the internal validity of the study because of the wide variability of these kinds of tests. The researcher, however, took steps to reduce this threat. Scorer bias was eliminated by making an objective test, and the distracters were plausible so that the answers to the test were not obvious. The items of the test were referenced to the objectives of the material being studied in the course. The test underwent an expert review and revision, and the test was pilot-tested with participants who were not selected in the study (Orcher, 2005).

Researcher Bias

A researcher's philosophy or personal feelings about a program could bias his/her evaluation of that program. In addition, this researcher had been substantially involved in the supplemental instruction program from its inception and could have found it difficult to maintain her impartiality. To lessen this bias, the Algebra I Assessment test and the MSLQ were objective measures. The focus groups and interviews were monitored by the researcher and co-facilitator, thus providing a check and balance.

Limited Sample

The researcher conducted this program evaluation with students in the last semester of the implementation of the Title III grant. This limited sample may have yielded students in the spring semester of 2007 who were different in their reaction to the SI program. This limitation should be lessened because the SI and non-SI groups were not significantly different in demographics or prior algebra knowledge. However, there was no guarantee that the results of this one semester evaluation were typical of the results throughout the Title III grant.

Implications

Developmental Mathematics

Based on the results of this research, Mid-Atlantic Community College should continue to use supplemental instruction in developmental mathematics and expand its use into non-developmental math courses. Castator and Tollefson (1996) found that underprepared students earned lower grades than other student groups, and that they earned high grades in college-level courses when developmental course enrollment preceded or was concurrent with enrollment in college-level courses. Students also need additional support when they enroll in these developmental courses. Some researchers have recommended the use of supplemental instruction to increase students' success in developmental courses (Boylan, 1997; Wright, et al., 2002). This research supports their ideas by showing that students in SI classes earn higher grades, withdraw in lower numbers, persist in college, and complete the course in larger numbers than their non-SI counterparts.

Training

The continuation and expansion of the SI program must be accompanied by a stricter implementation of training and meeting sessions for SI Leaders along with professional development for faculty. Researchers stress that training is critical for SI programs to be successful (Blanc, et al., 1983; Boylan & Saxon, 1999; Burmeister, 1996; Congos & Schoeps, 1993). The following components should be included in the training program:

1. New SI Leaders must attend training before working with SI sections. This training will emphasize collaborative learning and assisting students to find their own answers.
2. Faculty development in collaborative and active learning strategies needs to be made available to faculty on a regular basis. Summer seminars of the type originally planned in the Title III program can be scheduled to give the faculty the information they need to adapt their teaching strategies to those of an active mode of learning.

3. SI Leaders should be required to meet as a group on each campus once per month and as a college group once per semester. These meetings would be opportunities for additional training and sharing among the SI Leaders.
4. All training should emphasize that SI Leaders must work with their faculty members and provide assistance to students using the same approaches as the faculty.

SI Sessions

In the SI model used in the Title III grant and recommended by the University of Missouri at Kansas City, attendance at the out-of-class sessions is recommended by the faculty but voluntary on the part of the students. Researchers have recommended that attendance at sessions be required (Hodges et al., 2001; Hodges & White, 2001; McCarthy et al., 1997; Ramirez, 1997; Visor et al., 1992; Wright et al., 2002). Hodges et al. found that students who were mandated to attend the SI sessions did as well as those who attended voluntarily. This researcher recommends, therefore, that developmental classes be scheduled to allow for a non-credit mandatory laboratory period in which each class will have an SI session. Other voluntary SI sessions will also be scheduled at the convenience of the class, but this one laboratory session will be mandatory for all students.

Motivated Strategies for Learning Questionnaire

A claim of SI that has not been investigated in prior research is that the method of SI increases student cognitive and metacognitive strategies. Given that there were three class interventions with the pre-/post-test and MSLQ, the researcher did not give the MSLQ at the beginning and end of the class. Thus, the researcher could not determine the prior cognitive, metacognitive, or study skills strategies of the students. The researcher recommends that the MSLQ should be given at the beginning of each SI class with feedback given to each student on their scores and how to improve in their areas of weakness (Pintrich et al., 1991). At the end of the semester, the MSLQ should be given again to measure the changes and give further recommendations to the students.

SI Oversight

With the discovery of the SI class at the Chelsea campus that was not an SI class and inconsistencies in implementation among the campuses, the researcher recommends that a central SI coordinator be appointed to oversee the program. This coordinator's job would encompass the hiring and training of SI Leaders and scheduling faculty development. This coordinator would also be responsible for ongoing program evaluation with data collected every semester and tabulated each year for a yearly report.

Recommendations for Further Research

Withdrawal Rates

Researchers have found that SI classes have lower rates of withdrawal within the semester (Burmeister, 1996; Ogden et al., 2003; UMKC, 2003). This researcher found a difference in the withdrawal rates for the SI and non-SI sessions when checking for differential attrition. It would be a matter for further study to examine the withdrawal rates for SI classes compared to non-SI classes. It seems that the preliminary result from the research study shows that the SI classes had a dramatically lower withdrawal rate than their non-SI counterparts and should be investigated further to determine if this difference is statistically significant.

Larger Sample Size

This study only included developmental Algebra I classes where SI sections were compared to non-SI sections. This researcher would like to replicate the study with more sections to investigate if those results that were marginally significant ($.05 < p < .10$) would become significant differences. These near significant results of course completion rate and persistence rate need to be examined for all developmental math classes, comparing SI to non-SI sections. Developmental math classes are known as gatekeeper courses because students who fail often become those who do not persist in college (Boylan, 2002). It is important to establish that SI does yield significantly different results so that SI can be retained and assist students to complete their courses and persist in college.

Motivation

The MSLQ should be used as a pre- and post-test to measure changes in students' motivation, metacognitive and cognitive strategies, and study skills strategies. SI has been touted as a way to improve these student attributes, but this study was the first that used the MSLQ to investigate those qualities. However, causation cannot be implied because no baseline was established with a pre-test. A better training program for the SI Leaders and faculty should be followed by a larger study of the SI program that investigates these student attributes through the administration of the MSLQ as a pre- and post-test. Emphasis in the SI sessions on organization, critical thinking, making connections, metacognitive self-regulation, collaborative learning, and help-seeking should raise student scores on the MSLQ. This increase in scores will bring emphasis to the importance of not only teaching the material but also teaching these skills. This increase in appropriate training, coupled with the SI Leaders emphasizing the acquisition of these metacognitive and study skills in the SI sessions should be investigated to determine their effectiveness.

Mandatory SI Sessions

The recommendation for a mandatory SI session should be investigated to compare those classes to classes without SI. This mandatory session will require classroom utilization and possible other costs. If requiring the attendance is shown to improve student learning, retention, or course completion, then it should be continued. If not, then fiscal constraints would cause this mandatory attendance to be changed back to voluntary.

Persistence

The claim has been made that the higher cost of the SI program than of a traditional tutoring program is offset by the persistence of the SI students in college (Burmeister, 1996). The SI Leaders are paid while attending class, holding SI sessions, planning with the faculty, and training. On the surface, this cost for SI appears to be a much higher cost than tutoring. Further research should be done to compare the cost of the SI program to the savings incurred by the college when a student is retained. While college officials may be hesitant to institutionalize SI because of its apparent cost, the positive results of such a study could resolve this issue.

Conclusion

The ability of the United States to retain its standing in the world economy rests on its ability to keep up with the pace of technological advancements. This ability depends on the supply of math, science, engineering, and technology graduates from higher education. However, the United States is falling behind in the supply of these graduates, and fewer and fewer students are choosing to major in these fields. In order to increase the supply of graduates in these scientific fields, the United States must do a better job of bridging the gap between with what skills a student enters college and the skills necessary to be successful in science and math careers. Supplemental instruction, as developed by the University of Missouri at Kansas City, has been shown to improve students' performance, retention, and metacognitive skills in high-risk courses.

With a pass rate at 50% in their developmental courses, Mid-Atlantic Community College applied for a Title III grant to improve performance in developmental studies. Upon award of the grant, MACC adopted the supplemental instruction learning assistance program in an effort to improve its developmental students' success rate. This program evaluation examined the results of the supplemental instruction implementation in developmental mathematics. During this evaluation the researcher gathered information on faithfulness to the MACC grant; student success, persistence rates, final grades, and student levels of metacognitive and study skills. As the Title III grant ended and MACC pondered how and why to continue supplemental instruction, this program evaluation provided valuable information that could be used to make decisions about the future of SI at MACC.

In Patton's utilization-focused evaluation framework (1997), the implementation, intermediate, and ultimate level goals were addressed by the three research questions. First, the implementation level goal was not met in three instances as demonstrated from the lack of training for the SI Leaders and faculty, the SI website, and lack of communication between the faculty and SI Leaders. One area that was implemented correctly was the interaction between the students and the SI Leaders. Second, the intermediate level goal was met as demonstrated by the higher levels of course completion, persistence, and learning gains by the SI group. Last, the ultimate level goal was not met as demonstrated by the lack of significant difference in the MSLQ scores between the SI and non-SI groups.

Taken in concert with the supporting literature, the implications of the findings are rich. Mid-Atlantic Community College should retain and expand the SI program into non-developmental math courses. The experiment with SI undertaken through the Title III grant needs to be institutionalized with training for the SI Leaders and faculty and SI sections available for high-risk courses throughout the math curriculum. Even though the application of SI to developmental math has been rare, this study shows that students are more successful when SI was included in the developmental math program. The long-term impact of SI has the potential to retain current students, help them to be successful in developmental and then college transfer math courses, and then complete their college careers at MACC.

References

Astin, A. (1996). Involvement in learning revisited: Lessons we have learned. *Journal of College Student Development, 37*(2), 123-134.

Bandalos, D. L., Finney, S. J., & Geske, J. A. (2003). A model of statistics performance based on achievement goal theory. *Journal of Educational Psychology, 95*(3), 604-616.

Barise, A. (2000). The effectiveness of case-based instruction vs. the lecture-discussion method in multi-cultural social work. *Dissertation Abstracts International, 61* (6-A), 2181.

Barr, R. B., & Tagg, J. (1995, November/December). From teaching to learning: A new paradigm for undergraduate education. *Change, 27,* 12-25.

Bers, T. H., & Smith, K. E. (1991). Persistence of community college students: The influence of student intent and academic social integration. *Research in Higher Education, 32*(5), 539-556.

Blanc, R. A., DeBuhr, L. E., & Martin, D. C. (1983). Breaking the attrition cycle: The effects of supplemental instruction on undergraduate performance and attrition. *The Journal of Higher Education, 54*(1), 80-90.

Borja, R. R. (2005, September 28). Companies unveil projects to improve math, science learning. *Education Week, 25*(5), 6.

Bowles, T. J., & Jones, J. (2003/2004a). An analysis of the effectiveness of supplemental instruction: The problem of selection bias and limited dependent variables. *Journal of College Student Retention, 5*(2), 235-243.

Bowles, T. J., & Jones, J. (2003/2004b). The effect of supplemental instruction on retention: A bivariate probit model. *Journal of College Student Retention, 5*(4), 431-437.

Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development.* Thousand Oaks, CA: Sage.

Boylan, H. R. (1997). Exploring alternatives to remediation. *Journal of Developmental Education, 22*(3), 2-8.

Boylan, H. R. (2002). *What works: Research-based best practices in developmental education.* Lenoir, NC: Forbes.

Boylan, H. R., Bliss, L. B., & Bonham, B. S. (1997). Program components and their relationship to student performance. *Journal of Developmental Education, 20,* 2-4.

Boylan, H. R., Bonham, B., Claxton, C., & Bliss, L. (1992, November). *The state of the art in developmental education: Report of a national study.* Paper presented at the First National Conference on Research in Developmental Education, Charlotte, NC.

Boylan, H. R., & Saxon, D. P. (1999). *What works in remediation: Lessons from 30 years of research.* Retrieved July 7, 2005, from http://www.nade.appstate.edu/reserve_reading/what_works.htm

Bracey, G. W. (2001, May). Does higher tech require higher skills? *Phi Delta Kappan, 82*(9), 715-716.

Briedenhann, J., & Butts, S. (2005, March). Utilization-focused evaluation. *The Review of Policy Research, 22*(2), 221-244.

Brooks-Leonard, C. (1991). Demographic and academic factors associated with first-to-second term retention in a two-year college. *Community/Junior College Quarterly, 15,* 57-69.

Burmeister, S. (1996, Summer). Supplemental instruction: An interview with Deanna Martin. *Journal of Developmental Education, 20*(1), 22-26.

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research.* Boston: Houghton-Mifflin.

Casazza, M. E., & Silverman, S. L. (1996). *Learning assistance and developmental education.* San Francisco: Jossey-Bass.

Castator, M. M., & Tollefson, N. (1996). Underprepared students and the college curriculum: Identifying high risk courses. *Journal of Applied Research in the Community College, 3*(2), 179-200.

Clump, M. A. (2003). To attend or not to attend: Is that a good question? *Journal of Instructional Psychology, 30*(3), 220-224.

Cohen, A. M., & Brawer, F. G. (2003). *The American community college* (4th ed.). San Francisco: Jossey-Bass.

Commander, N. E., Stratton, C. B., Callahan, C. A., & Smith, B. D. (1996). A learning assistance model for expanding academic support. *Journal of Developmental Education, 20*(2), 8-16.

Community College Survey of Student Engagement. (2005). *Engaging students, challenging the odds.* Austin, TX: University of Texas at Austin. Retrieved October 1, 2006, from http://www.ccsse.org/publications/CCSSE_reportfinal2005.pdf

Congos, D. H. (2002). How supplemental instruction stacks up against Arthur Chickering's 7 principles for good practice in undergraduate education. *Research and Teaching in Developmental Education, 19*(1), 75-83.

Congos, D. H. (2003). Is SI's help helpful? *Research and Teaching in Developmental Education, 19*(2), 79-90.

Congos, D. H., & Schoeps, N. (1993). Does supplemental instruction really work and what is it anyway? *Studies in Higher Education, 18*(2), 165-176.

Congos, D. H., & Schoeps, N. (1998). Inside supplemental instruction sessions: One model of what happens that improves grades and retention. *Research and Teaching in Developmental Education, 15*(1), 47-62.

Congos, D. H., & Schoeps, N. (1999). Methods to determine the impact of SI programs on colleges and universities. *Journal of College Student Retention, 1*(1), *59-82.*

Congos, D. H., & Stout, B. M. (2001). 20 FAQ'S from faculty about supplemental instruction programs. *Research and Teaching in Developmental Education, 18*(1), 41-49.

Cronbach, L. J. & Suppes, P. (Eds.). (1969). *Research for tomorrow's schools: Disciplined inquiry of education.* New York: Macmillan.

Cross, K. P. (1976). *Accent on learning.* San Francisco, CA: Jossey-Bass.

DeLaOssa, P. (2005, Fall). Hear my voice: Alternative high school students' perceptions and implications for school change. *American Secondary Education, 34*(1), 24-39.

Donovan, R. (1974). *Alternatives to the revolving door: FIPSE National Project II.* Bronx, NY: Bronx Community College.

Fairdata. (2000). *Socio-economic data from the 2000 census.* Retrieved November 5, 2006, from http://www.fairdata2000.com/SioEconMapper/

Fitzpatrick, J. L., Sanders, J. R., & Worthen B. R. (2004). *Program evaluation: Alternative approaches and practical guidelines* (3rd ed.). Boston: Pearson.

Gattis, K. W. (2002). Responding to self-selection bias in assessments of academic support programs: A motivational control study of supplemental instruction. *The Learning Assistance Review, 7*(2), 26-36.

Grady, P., & Carter, A. (2001). Instructional support across the curriculum: The multi-purpose academic learning lab. *International Journal of Instructional Media, 28*(4), 431-436.

Greer, L. R. (1980). *Persistence and academic success among non-traditional age students at a junior college.* Paper presented at the annual forum of the Association for Institutional Research, Atlanta, GA. (ERIC Document Reproduction Service No. ED 189942).

Hamman, D., Berthelot, J., Saia, J., & Crowley, E. (2000). Teachers' coaching of learning and its relation to students' strategic learning. *Journal of Educational Psychology, 92* (2), 342-348.

Hancock, D. (2004). Cooperative learning and peer orientation effects on motivation and achievement. *Journal of Educational Research, 97*(3), 159-166.

Hendriksen, S. I., Yang, L., Love, B., & Hall, M. C. (2005, Spring). Assessing academic support: The effects of tutoring on student learning outcomes. *Journal of College Reading and Learning, 35*(2), 56-65.

Hensen, K. A., & Shelley, M. C. (2003, March/April). The impact of supplemental instruction: Results from a large, public midwestern university. *Journal of College Student Development, 44*(2), 250-259.

Hodges, R., Dochen, C., & Joy, D. (2001). Increasing students' success: When supplemental instruction becomes mandatory. *Journal of College Reading and Learning, 31*(2), 143-156.

Hodges, R. B., & White, W. G. (2001). Encouraging high-risk student participation in tutoring and supplemental instruction. *Journal of Developmental Education, 24*(3), 2-10, 43.

Jones, C. H. (1984). Interaction of absences and grades in a college course. *The Journal of Psychology, 116,* 133-136.

Karabenick, S. A., & Knapp, J. R. (1988). Help seeking and the need for academic assistance. *Journal of Educational Psychology, 80*(3), 406-408.

Klingner, J. K., & Vaughn, S. (1999). Students' perceptions of instruction in inclusion classrooms: Implications for students with learning disabilities. *Exceptional Children, 66* (1), 23-32.

Kochenour, E. O., Jolley, D. S., Kaup, J. G., Patrick, D. L., Roach, K. D., & Wenzler, L. A. (1997). Supplemental instruction: An effective component of student affairs programming. *Journal of College Student Development, 38*(6), 577-585.

Lanni, J. C. (1997). *Modeling student outcomes: A longitudinal study.* Paper presented at the Annual Forum of the Association for Institutional Research, Orlando, FL. (ERIC Document Reproduction Service No. ED 410870).

Martin, D. D., & Arendale, D. R. (1994). *Supplemental instruction: Increasing achievement and retention.* San Francisco, CA: Jossey-Bass.

McCarthy, A., Smuts, B., & Cosser, M. (1997). Assessing the effectiveness of Supplemental instruction: A critique and a case study. *Studies in Higher Education, 22*(2), 221-231.

McWilliams, Jr. (2006, November 2). Unemployment rate in Hampton Roads edges up to 3.8%. *The Virginian-Pilot.* Retrieved November 5, 2006, from http://home.hamptonroads.com/stories/print.cfrm?story=113670&ran=67518

Ogden, P., Thompson, D., & Russell, A. (2003). Supplemental instruction: Short and long-term impact. *Journal of Developmental Education, 26*(3), 2-4, 6, 8.

Olson, L. (2006, May 19). Skills for work, college readiness are found comparable. *Education Week, 25*(36), 1, 19.

Olstad, R. G., & Beal, J. L. (1984). The science and mathematics teacher shortage: A study of recent graduates. *Science Education, 68*(4), 397-402.

Orcher, L. T. (2005). *Conducting research: Social and behavioral science methods.* Glendale, CA: Pyrczak.

Pascarella, E. T., & Terenzini, P. T. (1998). Studying college students in the 21st century: Meeting new challenges. *The Review of Higher Education, 21*(2), 151-165.

Patton, M. Q. (1997). *Utilization-focused evaluation: The new century text* (3rd ed.). Thousand Oaks, CA: Sage.

Perin, D. (2004, August). Remediation beyond developmental education: The use of learning assistance centers to increase academic preparedness in community colleges. *Community College Journal of Research and Practice, 28*(7), 559-82.

Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1991). *A Manual for the Use of the Motivated Strategies for Learning Questionnaire.* Ann Arbor, MI: University of Michigan.

Pintrich, P. R., Smith, D., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educational and Psychological Measurement, 53* (3), 801-813.

Ramirez, G. M. (1997). Supplemental instruction: The long-term impact. *Journal of Developmental Education, 21*(1), 2-4, 6, 8, 10, 28.

Reittinger, D. L., & Palmer, T. M. (1996). Lessons learned from using supplemental instruction: Instructional models for practical application. *Research and Teaching in Developmental Education, 13*(1), 57-68.

Rittschof, J. A., & Griffin, B. W. (2001). Reciprocal peer tutoring: Re-examining the values of a co-operative learning technique to college students and instructors. *Educational Psychology, 21* (3), 313-332.

Roueche, J., & Snow, J. (1977). *Overcoming learning problems*. San Francisco, CA: Jossey-Bass.

Schwartz, M. D. (1992). Study sessions and higher grades: Questioning the causal link. *College Student Journal, 26*(3), 292-299.

Schwitzer, A. M., Duggan, M. H., Ericksen, K., Moncrief, K. O., & Nelson, E. K. (2006). Program evaluation in human service education: Applying a chain of objectives model. *Human Service Education, 26*(1), 33-48.

Schwitzer, A. M., McGovern, T. V., & Robbins, S. B. (1991). Adjustment outcomes of a freshman seminar: A utilization-focused approach. *Journal of College Student Development, 32,*484-489.

Sharma, M. (2004). Tapping into the potential of focus groups for research in alcohol and drug education. *Journal of Alcohol and Drug Education, 48*(3), 3-6.

Shults, C. (2001). *Remedial education: Practices and policies in community colleges (*American Association of Community Colleges Rep. No. AACC-RB-00-2). Washington, D. C.: Community College Press.

Spencer, N. M. (1992). Chaos or co-ordination: Organizational aspects of tutoring large classes. *International Journal of Mathematical Education in Science and Technology, 23*(4), 589-593.

Stern, S. (2001). *Learning assistance centers: Helping students through* (Report No. EDO-JC-01-07). Los Angeles, CA: ERIC Clearinghouse for Community Colleges. (ERIC Document Reproduction Service No. ED455901).

Swager, S., Sarah, C., & Orlowski, M. A. (1995). *An analysis of student motivations for withdrawal in a community college.* Paper presented at the Annual Forum of the Association for Institutioanl Research, Boston, MA. (ERIC Document Reproduction Service No. ED 387000).

Thomas, P. V., & Higbee, J. L. (2000). The relationship between involvement and success in developmental algebra. *Journal of College Reading and Learning, 30*(2), 222-241.

Thorndike, R. M., & Dinnel, D. L. (2000). *Basic Statistics for the Behavioral Sciences.* Upper Saddle River, NJ: Prentice-Hall.

Mid-Atlantic Community College. (2004). *About Mid-Atlantic Community College.* Retrieved June 17, 2005, from http://www.tcc.edu/welcome/about/

Mid-Atlantic Community College. (2006) *TCC Fact Book.* Norfolk, VA: Author.

Mid-Atlantic Community College. (2000). *Title III Grant Application: Strengthening Institutions Program.* Norfolk, VA: Author.

Tinto, V. (1987) *Leaving college: Rethinking the causes and cures of student attrition.* Chicago: University of Chicago Press.

University of Missouri –Kansas City (2003, December). *Supplemental Instruction: National Data Summary, 1998-2003.* Kansas City: Author.

Virginia Community College System. (2003). *A strategic direction: Dateline 2009.* Retrieved August 1, 2006, from http://www.so.cc.va.us/dateline2009/dateline2009nov23.pdf

Visor, J. N., Johnson, J. J., & Cole, L. N. (1992). The relationship of supplemental instruction to affect. *Journal of Developmental Education, 16*(2), 12-14, 16-18.

Walters, A. K. (2005, August 5). Business groups warn of gap in science and math. *The Chronicle of Higher Education, 51*(48), A21.

Waycaster, P. (2001). Factors impacting success in community college developmental mathematics courses and subsequent courses. *Community College Journal of Research and Practice, 25,* 403-416.

Weissman, J. Bulakowski, C., & Jumisko, M. (1997). Using research to evaluate developmental education programs and policies. *New Directions for Community Colleges, 100,* 73-80.

Wheland, E., Konet, R. M., & Butler, K. (2003). Perceived inhibitors to mathematics success. *Journal of Developmental Education, 26(3),* 18-20, 22, 24, 26-27.

Wild, L., & Ebbers, L. (2002). Rethinking student retention in community colleges. *Community College Journal of Research and Practice, 26,* 503-519.

Wilke, R. R. (2003). The effect of active learning on student characteristics in a human physiology course for non majors. *Advances in Physiology Education, 27* (4), 207-220.

Windham, P. (1995). *The importance of work and other factors to attrition: A comparison of significancy and odds ratio for different outcomes.* Paper presented at the Annual Conference of the Southeastern Association for Community College Research, Asheville, NC. (ERIC Document Reproduction Service No. ED 385312).

Wright, G. L., Wright, R. R., & Lamb, C. E. (2002). Developmental mathematics education and supplemental instruction: Pondering the potential. *Journal of Developmental Education, 26*(1), 30-35.

Xu, Y., Hartman, S., Uribe, G., & Mencke, R. (2001, Fall). The effects of peer tutoring on undergraduate students' final examination scores in mathematics. *Journal of College Reading and Learning, 32*(1), 22-31.

Zusho, A., Pintrich, P. R., & Coppola, B. (2003). Skill and will: The role of motivation and cognition in the learning of college chemistry. *International Journal of Science Education, 25*(9), 1081-1094.

Appendix A

Letter of Consent for Study from Mid-Atlantic Community College

TIDEWATER COMMUNITY COLLEGE
From here, go anywhere.™

DISTRICT ADMINISTRATION

October 25, 2006

Ms. Marilyn Peacock
Interim Dean of Business, Social Sciences,
Public Services, and Technology
Tidewater Community College, Norfolk Campus
300 Granby Street
Norfolk, VA 23510

Dear Ms. Peacock:

I write in response to your request to use TCC's spring 2007 developmental Math 03 classes as a source for program evaluation of Supplemental Instruction. I have reviewed your proposed strategies for evaluation and approve of your random selection of 20 different classes for pre/post testing and for survey purposes. The study is approved with the understanding that all activities are purely voluntary on the student and faculty member's part. Additionally, all data will be reported in the aggregate and will be used solely for research purposes.

I would be interested in the final results of your study as it could provide insight into the development of our Quality Enhancement Plan (QEP). Please let me know if I can assist in any other way.

Sincerely,

Lisa S. Kleiman
Director-Institutional
Effectiveness

c. Dr. Alex Kajstura

Appendix B

Interview Guide for Faculty Interviews

Moderator's Guide
Faculty Interviews

Background Information:
1. How long have you been teaching math at this institution?
2. How long have you been teaching math at all institutions?
3. Describe your teaching style.

Prompts
- Lecture with no questions
- Lecture with questions
- Group-work
- Student board work

4. How do you adopt your teaching style for use in Supplemental Instruction sections vs. non-Supplemental Instruction sections?

Prompts
- Use of collaborative learning
- Use of tutoring
- Planning with tutor

SI Leader:
1. Please describe your planning sessions with your SI Leader.

Prompts
- Set time in your office
- Set time at the beginning or end of class
- At the beginning or end of class as needed
- No planning

2. Describe how your SI Leader functions in your classroom.

Prompts
- Sits and listens but does not participate
- Sits and listens and assists students when in groups
- Goes over homework with students at the board

3. How does the SI Leader involve you in planning for the outside of class sessions?

Prompts
- Questions you about what needs to be covered in sessions
- Asks for supplemental material or worksheets for sessions
- Asks about difficult areas for particular students

Supplemental Instruction:
1. How would you describe the mission of Supplemental Instruction?

Prompts
- Improvement of student learning in course
- Improvement in student pass rates
- Improvement in retention of students
- Long-term improvement in students' learning modalities

2. Describe how you fit into this mission.
Prompts

- Recommend students to attend SI sessions
- Plan with SI Leader
- Utilize student services when a student shows a need
- Make students work through questions without supplying all the answers
- Check homework
- Require that students show work and be able to support their conclusions

3. What effect has being involved in Supplemental Instruction had on your teaching style?
Prompts

- Use collaborative learning
- Less lecture
- More focus on learning of individual students
- Give students problems during class to solve

4. Describe any formal or informal professional development activities that being involved with Supplemental Instruction has afforded you.
Prompts

- Attended college class on improving learning
- Attended seminar which stressed learning
- Informal discussions with other faculty about learning
- Read articles and/or books about learning

5. Tell me a story that stands out in your mind about students involved in Supplemental Instruction.
6. What are the best features of Supplemental Instruction?
Prompts

- Having SI Leader in classroom
- Having sessions outside of class
- Having SI Leader to plan activities with
- Students' reliance on SI Leader

7. What are the worst features of Supplemental Instruction?
Prompts

- Having SI Leader in classroom
- Having sessions outside of class
- Having SI Leader to plan activities with
- Students' reliance on SI Leader

8. If you could change one aspect of Supplemental Instruction, what would you change?
Prompts

- Attendance at SI sessions is not required
- Cannot give extra credit for SI session attendance
- Selection of particular SI Leader
- More/less use of SI Leader
- More/less sections or type of sections selected for SI

Appendix C

Moderator's Guide for Student Focus Group

Moderator's Guide
Student Focus Group

I. Introduction (5 minutes)

A. "The purpose of this focus group is to explore (a) how the Supplemental Instruction is viewed by its participants; and (b) what kinds of learning and study strategies you use in your developmental Algebra 1 class.

B. Moderator introductions: "My name is Marilyn Peacock and this is Mary Landon. Our job is to facilitate your discussion, record your responses, and keep time to make sure that we thoroughly cover ALL of the topics."

C. Group Guidelines

1. Moderator should speak less than 1/3 of the time
2. While one moderator facilitates the discussion, the other will be taking notes for analysis BUT NO NAMES will be recorded
3. Respect the confidentiality of each participant by not quoting or attributing comments to anyone outside of the group.
4. All should participate.
5. Discussion and disagreement are encouraged; no need to reach consensus.
6. No right or wrong opinions; just different points of view
7. Only one person should speak at a time – no side conversations

D. Audio recording for data analyses

1. ***ONLY*** the research team will have access to the tapes
2. Will be used ***ONLY*** for data analyses
3. ***ONLY*** group results will be reported; no individuals will be identified, however we may us some direct quotations to emphasize a particular point.
4. ***Confidentiality:*** Please keep confidential all information that others share with the group when you leave.

E. "If there are no questions or concerns, let's begin!"

II. Introduction of Participants and Warm-up (10-15 minutes)

A. First name

B. **Warm-up questions** – Ask everyone to write their word on one of the colored 5x8 cards corresponding to each of the following questions. Make sure ***everyone responds*** to this item AND ***record responses*** on newsprint. Collect, record, and process words for question #1 before moving to question #2. (Note: 5x8 cards facilitate analysis while newsprint facilitates group processing.)

1. Describe the Supplemental Instruction Program in a word (YELLOW 5x8 cards)

2. Describe the Supplemental Instruction Program in a word as you think others see it (GREEN 5x8 cards).

III. Topic Discussion (80-90 minutes; 20 minutes per topic)

A. The first topic to consider involves the **learning strategies** you use in this course.

1. What are some of the learning strategies you are **currently using** in your math class?
<u>Prompts</u>
* reading strategies
* summarizing
* relating to previous knowledge
* organizing main ideas
* time and place
* self effort
* collaborative learning

2. Let's talk about your experiences in working in groups in a math class. How is that working for you?

3. Which of these learning strategies have you found to be most effective? Least effective?

B. The second topic involves the extent to which you are involved in your own learning.

1. How do you figure out what you need to study when preparing for a test?
Prompts
* teacher outline
* practice tests
* homework
* practice session
* working extra problems
* other

2. Which of these have worked best for you? Least?

C. This topic explores the values or contribution you place on the supplemental Instruction program.

1. Would you encourage family members or friends to attend a Supplemental Instruction section of math? Why / why not?

2. What were the best features/worst features of the supplemental instruction program?

3. What **changes** have you seen in yourself since you started this math class?
- cognitive
- affective
- other

IV. Wrap-up (10-15 minutes)

A. If you had **one piece of advice** for the Math Department, what would it be? - Ask everyone to briefly record their advice on the CHERRY 5x8 cards. Make sure ***everyone responds*** to this item. (5x8 cards facilitate analysis while newsprint facilitates group processing.)

THANK YOU!!!

Appendix D

Algebra I Assessment Test

Algebra I
Assessment Test

Mid-Atlantic Community College

Instructions for Students:

Read carefully before you begin:

1. **You have 30 minutes to work the problems on this test.**
2. **Write your empl ID # on the answer sheet.**
3. **Mark your answers on the answer sheet—do not mark on the test itself.**
4. **Do not guess. Answer as many questions as you can. Do not worry if you do not finish the test.**
5. **Calculators may not be used.**
6. **Remain seated and quiet until your instructor collects the tests at the end of the time limit.**
7. **Turn in your answer sheet, test booklet, and scratch paper.**
8. **This score does not affect your grade in the course. You may obtain your score from your instructor in several days.**

Algebra I
Time – 30 minutes

1. Evaluate: $\frac{(-3)(-4)}{-6}$

A. 2
B. -2
C. -3
D. 3

2. Evaluate: $7 + 3(5 - 8)$

A. 30
B. 42
C. -30
D. -2

3. If $3x + 4 = 7x - 2$, then x =

A. $\frac{3}{2}$
B. $\frac{3}{5}$
C. $\frac{1}{2}$
D. $\frac{1}{5}$

4. Simplify: $\frac{6m^2 + 2m}{2m}$

A. $6m^2$
B. $6m^2 + 1$
C. $3m$
D. $3m + 1$

5. Simplify: $5(a - 2)$

A. $a - 10$
B. $5a - 2$
C. $5a - 7$
D. $5a - 10$

6. If $x = -1$, then $2x^3 + 7x^2 - 7x - 30 =$

A. -28
B. -18
C. -32
D. -46

7. Simplify: $(2x + 5)(3x - 4)$

A. $6x^2 - 20$
B. $6x^2 + 7x - 20$
C. $6x^2 - 7x - 20$
D. $5x^2 + 1$

8. Simplify: $14a + 16b - a + 2b$

A. $14 + 18b$
B. $13a + 14b$
C. $13a + 18b$
D. $13a^2 + 18b^2$

9. Factor: $ab^3 + ba^3$

A. $ab(b^2 + a^2)$
B. $ab(b^3 + a^3)$
C. $ab^2(b + a)$
D. $a^2b(a + b)$

10. Simplify: $(-2x^2)(3x^2y^2)(-y)$

A. y
B. $6x^4y^3$
C. $-6x^2y^2$
D. x^4y

11. Simplify: $\frac{15x^6y}{3x^2y^2}$

A. $5x^4y^2$
B. $\frac{5x^3}{y^2}$
C. $\frac{5x^4}{y}$
D. $\frac{12x^4}{y^2}$

12. Simplify: $(4x + 3)^2$

A. $16x^2 + 24x + 9$
B. $16x^2 + 9$
C. $16x^2 + 12x + 9$
D. $16x^2 + 7x + 9$

13. Simplify: $(2x + 2) – (x – 4)$

A. $x + 6$
B. 9
C. $4x – 2$
D. $2x – 6$

14. Factor: $2x^2 -5x – 3$

A. $(2x – 1)(x + 3)$
B. $(2x + 3)(x – 1)$
C. $(2x + 1)(x – 3)$
D. $(2x – 3)(x + 1)$

15. Which of the following is a factor of:
$ax + bx – 2ay – 2by$

A. $(a + x)$
B. $(x + y)$
C. $(x + 2y)$
D. $(a + b)$

16. Which of the following is a factor of:
$x^2 - x - 12$

A. $x + 2$
B. $x + 3$
C. $x - 6$
D. $x + 4$

17. Simplify: $\frac{4x}{9y} \cdot \frac{3y}{2x^2}$

A. $\frac{8x^3}{27y^2}$
B. $\frac{2}{3xy}$
C. $6x$
D. $\frac{2}{3x}$

18. If $4(2x + 5) - (x + 5) = 0$, then $x =$

A. 0
B. $\frac{-15}{7}$
C. $\frac{-25}{7}$
D. $\frac{-18}{11}$

19. On a certain map, 2 inches represents 100 miles. How many miles would 5 inches represent?

A. 200 miles
B. 250 miles
C. 500 miles
D. 1000 miles

20. The sum of two numbers is 15. If one of the numbers is four times as large as the other, what is the value of the smaller number?

A. 5
B. 2
C. 4
D. 3

21. Factor: $x^2 - 64$

A. $(x + 8)^2$
B. $(x - 8)^2$
C. $(x + 8)(x - 8)$
D. $(x + 32)(x - 32)$

22. Simplify: $\frac{2x^2 + 8x}{x^2 - 16} \div \frac{4x^2}{x^2-x-12}$

A. $\frac{x + 3}{2x}$

B. $\frac{(2 + x)(x - 12)}{8}$

C. $\frac{8x^3}{(x-4)(x-3)}$

D. $\frac{2 - x}{x - 4}$

23. Simplify: $\frac{5}{x} + \frac{3}{x+3}$

A. $\frac{8}{x+ 3}$

B. $\frac{8}{x(x + 3)}$

C. $\frac{8x + 3}{x + 3}$

D. $\frac{8x + 15}{x(x + 3)}$

24. If P = 2L + 2W, then W =

A. P – L

B. $\frac{P}{2L + 2}$

C. $\frac{P - 2L}{2}$

D. $\frac{P - 2}{2L}$

25. Solve by factoring: $2x^2 - 7x - 15 = 0$

A. x = -5, 3
B. x = 5, -3/2
C. x = -5, 3/2
D. x = 7, -15

Algebra I Assessment Test

Answer Sheet

Empl ID (Student ID) _ _ _ _ _ _ _

Age ________ Female _____ Male _____

Race: White _____ Black _____ Asian _____ Hispanic _____ Other _____

In how many credit hours are you enrolled this semester? ______

How many hours are you employed every week? _____

1. __B__
2. _D___
3. _A___
4. _D___
5. _D___
6. _B___
7. _B___
8. _C___
9. _A___
10. _B____
11. _C____
12. _A____
13. _A____
14. ___C__
15. ___D__
16. __B___
17. __D___
18. __B___
19. __B___
20. __D___
21. __C___
22. __A___
23. __D___
24. __C___
25. __B___

Appendix E

Consent from University of Michigan to use MSLQ

From: Marie Bien <mabien@umich.edu>
To: "Marilyn Peacock" <tcpeacm@tcc.edu>
Date: 9/28/2006 8:07 AM
Subject: Re: MSLQ

My email below gives the complete address and you can use that as your label for mailing your check. I am putting it in the mail to you today. Marie

>My address is :
>
>Mrs. Marilyn L. Peacock
>4020 Breakwater Drive
>Portsmouth, VA 23703
>
>>From my online source I have your address as:
>
>University of Michigan
>610 E. University Avenue
>Rm 1413 SEB
>Ann Arbor, MI 48109-1259
>
>Is this the correct place to send the check? Should I mark it to your
>attention?
>
>
>
>Marilyn L. Peacock
>Interim Dean of Business, Social Sciences,
> Public Services, and Technology
>Norfolk Campus
>Tidewater Community College
>300 Granby Street
>Norfolk, VA 23510
>(757) 822 1191
>tcpeacm@tcc.edu
>
>>>> Marie Bien <mabien@umich.edu> 09/21/06 4:08 PM >>>
>I mail out the MSLQ for a fee of $20. Make your check payable to the
>University of Michigan. With this payment, you are allowed to use
>the MSLQ in any way that you need to but making sure you give the
>authors credit. Also, I am willing to send it out before I receive
>your check so you can get it as soon as possible. Please send me
>back your complete address and I will use that as my label. ...Marie
>
>____
>
>Marie-Anne Bien, Secretary
>The University of Michigan
>Combined Program in Education & Psychology (CPEP)
>610 East University, 1413 School of Education
>Ann Arbor, MI 48109-1259
>PH (734)647-0626; FAX (734) 615-2164
>mabien@umich.edu
>____
>

>>Hi Marie,
>>
>>I am a doctoral student at Old Dominion University in Virginia. I
>>would like to use the Motivated Strategies for Learning Questionnaire
>as
>>an instrument in my dissertation.
>>
>>Can you tell the specifics about the cost, how I get a copy, is the
>>manual included with the software, is there documentation on the
>>reliability and validity of the instrument included?
>>
>>I got your name from another website where they are using the MSLQ.
>If
>>you are not the contact person any more, would you please forward my
>>email to the appropriate person.
>>
>>
>>
>>Marilyn L. Peacock
>>Interim Dean of Business, Social Sciences,
>> Public Services, and Technology
>>Norfolk Campus
>>Tidewater Community College
>>300 Granby Street
>>Norfolk, VA 23510
>>(757) 822 1191
>>tcpeacm@tcc.edu

Appendix F

Motivated Strategies for Learning Questionnaire

Student ID: _ _ _ _ _ _ _

Motivated Strategies for Learning Questionnaire[1]

Directions: In answering the following questions, think about your motivation for and study habits in courses you have taken recently or are currently taking in math. Using the scale below, please answer the following questions. Remember there are no right or wrong answers. If you think the statement is very true of you, fill in the circle for response 7; if a statement is not at all true of you, fill in the circle for response 1.

Very true to you ⑦←⑥←⑤←④→③→②→① Not at all true to you

⑦⑥⑤④③②① 1. In a class like this, I prefer course material that really challenges me so I can learn new things.

⑦⑥⑤④③②① 2. If I study in appropriate ways, then I will be able to learn the material in this course.

⑦⑥⑤④③②① 3. When I take a test, I think about how poorly I am doing compared with other students.

⑦⑥⑤④③②① 4. I think I will be able to use what I learn in this course in other courses.

⑦⑥⑤④③②① 5. I believe I will receive an excellent grade in this class.

⑦⑥⑤④③②① 6. I'm certain I can understand the most difficult material presented in the readings for this course.

⑦⑥⑤④③②① 7. Getting a good grade in this class is the most satisfying thing for me right now.

⑦⑥⑤④③②① 8. When I take a test I think about items on other parts of the test I can't answer.

⑦⑥⑤④③②① 9. It is my own fault if I don't learn the material in this course.

⑦⑥⑤④③②① 10. It is important for me to learn the course material in this class.

⑦⑥⑤④③②① 11.The most important thing for me right now is improving my overall grade point average, so my main
concern in this class is getting a good grade.

⑦⑥⑤④③②① 12. I'm confident I can learn the basic concepts taught in this course.

⑦⑥⑤④③②① 13. If I can, I want to get better grades in this class than most of the other students.

⑦⑥⑤④③②① 14. When I take tests I think of the consequences of failing.

⑦⑥⑤④③②① 15. I'm confident I can understand the most complex material presented by the instructor in this course.

⑦⑥⑤④③②① 16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.

⑦⑥⑤④③②① 17. I am very interested in the content area of this course.

⑦⑥⑤④③②① 18. If I try hard enough then I will understand the course material.

⑦⑥⑤④③②① 19. I have an uneasy, upset feeling when I take an exam.

⑦⑥⑤④③②① 20. I'm confident I can do an excellent job on the assignments and tests in this course.

⑦⑥⑤④③②① 21. I expect to do well in this class.

⑦⑥⑤④③②① 22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as
possible.

[1] The Motivated Strategies for Learning Questionnaire was developed by Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991) A Manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ). Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning, University of Michigan.

⑦⑥⑤④③②① 23. I think the course material in this class is useful for me to learn.

⑦⑥⑤④③②① 24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they
don't guarantee a good grade.

⑦⑥⑤④③②① 25. If I don't understand the course material, it is because I didn't try hard enough.

⑦⑥⑤④③②① 26. I like the subject matter of this course.

⑦⑥⑤④③②① 27. Understanding the subject matter of this course is very important to me.

⑦⑥⑤④③②① 28. I feel my heart beating fast when I take an exam.

⑦⑥⑤④③②① 29. I'm certain I can master the skills being taught in this class.

⑦⑥⑤④③②① 30. I want to do well in this class because it is important to show my ability to my family, friends, employer,
or others.

⑦⑥⑤④③②① 31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

⑦⑥⑤④③②① 32. When I study the readings for this course, I outline the material to help me organize my thoughts.

⑦⑥⑤④③②① 33. During class time I often miss important points because I'm thinking of other things.

⑦⑥⑤④③②① 34. When studying for this course, I often try to explain the material to a classmate or a friend.

⑦⑥⑤④③②① 35. I usually study in a place where I can concentrate on my course work.

⑦⑥⑤④③②① 36. When reading for this course, I make up questions to help focus my reading.

⑦⑥⑤④③②① 37. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.

⑦⑥⑤④③②① 38. I often find myself questioning things I hear or read in this course to decide if I find them convincing.

⑦⑥⑤④③②① 39. When I study for this class, I practice saying the material to myself over and over.

⑦⑥⑤④③②① 40. Even if I have trouble learning the material in this class, I try to do the work on my own, without help
from anyone.

⑦⑥⑤④③②① 41. When I become confused about something I'm reading for this class, I go back and try to figure it out.

⑦⑥⑤④③②① 42. When I study for this course, I go through the readings and my class notes and try to find the most
important ideas.

⑦⑥⑤④③②① 43. I make good use of my study time for this course.

⑦⑥⑤④③②① 44. If course readings are difficult to understand, I change the way I read the material.

⑦⑥⑤④③②① 45. I try to work with other students from this class to complete the course assignments.

⑦⑥⑤④③②① 46. When studying for this course, I read my class notes and the course readings over and over again.

⑦⑥⑤④③②① 47. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if
there is good supporting evidence.

⑦⑥⑤④③②① 48. I work hard to do well in this class even if I don't like what we are doing.

⑦⑥⑤④③②① 49. I make simple charts, diagrams, or tables to help me organize course material.

⑦⑥⑤④③②① 50. When studying for this course, I often set aside time to discuss course material with a group of students
from the class.

⑦⑥⑤④③②① 51. I treat the course material as a starting point and try to develop my own ideas about it.

⑦⑥⑤④③②① 52. I find it hard to stick to a study schedule.

⑦⑥⑤④③②① 53. When I study for this class, I pull together information from different sources, such as lectures, readings,
and discussions.

⑦⑥⑤④③②① 54. Before I study new course material thoroughly, I often skim it to see how it is organized.

⑦⑥⑤④③②① 55. I ask myself questions to make sure I understand the material I have been studying in this class.

⑦⑥⑤④③②① 56. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.

⑦⑥⑤④③②① 57. I often find that I have been reading for this class but don't know what it was all about.

⑦⑥⑤④③②① 58. I ask the instructor to clarify concepts I don't understand well.

⑦⑥⑤④③②① 59. I memorize key words to remind me of important concepts in this class.

⑦⑥⑤④③②① 60. When course work is difficult, I either give up or only study the easy parts.

⑦⑥⑤④③②① 61. I try to think through a topic and decide what I am supposed to learn from it rather than just reading
it over when studying for the course.

⑦⑥⑤④③②① 62. I try to relate ideas in this subject to those in other courses whenever possible.

⑦⑥⑤④③②① 63. When I study for this course, I go over my class notes and make an outline of important concepts.

⑦⑥⑤④③②① 64. When reading for this class, I try to relate the material to what I already know.

⑦⑥⑤④③②① 65. I have a regular place set aside for studying.

⑦⑥⑤④③②① 66. I try to play around with ideas of my own related to what I am learning in this course.

⑦⑥⑤④③②① 67. When I study for this course, I write brief summaries of the main ideas from the readings and my class
notes.

⑦⑥⑤④③②① 68. When I can't understand the material in this course I ask another student in this class for help.

⑦⑥⑤④③②① 69. I try to understand the material in this class by making connections between the readings and the
concepts from the lectures.

⑦⑥⑤④③②① 70. I make sure that I keep up with the weekly readings and assignments for this course.

⑦⑥⑤④③②① 71. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.

⑦⑥⑤④③②① 72. I make lists of important items for this course and memorize the lists.

⑦⑥⑤④③②① 73. I attend this class regularly.

⑦⑥⑤④③②① 74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.

⑦⑥⑤④③②① 75. I try to identify students in this class whom I can ask for help if necessary.

⑦⑥⑤④③②① 76. When studying for this course I try to determine which concepts I don't understand well.

⑦⑥⑤④③②① 77. I often find that I don't spend very much time on this course because of other activities.

⑦⑥⑤④③②① 78. When I study for this class, I set goals for myself in order to direct my activities in each study period.

⑦⑥⑤④③②① 79. If I get confused taking notes in class, I make sure I sort it out afterwards.

⑦⑥⑤④③②① 80. I rarely find time to review my notes or readings before an exam.

⑦⑥⑤④③②① 81. I try to apply ideas from course readings in other class activities such as lecture and discussion.

VITA

Marilyn Lawson Peacock

Work: (757) 822-1191	mpeacock@tcc.edu	4020 Breakwater Drive
Home: (757) 484-7923		Portsmouth, VA 23703

EDUCATION

Expected Date of Completion: May, 2008
Doctoral Candidate in Community College Leadership
Old Dominion University

June 1978 to August 1980
M.S. Mathematics
College of William and Mary

August 1971 to May 1975
B.S. (Honors) Mathematics
Madison College (now James Madison University)

HONORS and AWARDS
2007 Representative to VCCS Administrative Leadership Seminar
2006-2007 State Scholarship from Delta Kappa Gamma Society International
2005-2006 International Scholarship from Delta Kappa Gamma Society International
2005 Old Dominion University Honors Fellowship
1996 Life Membership for Virginia PTA
1992 Virginia Community College System Instructional Leadership Conference
1980 College of William & Mary Graduate Fellowship
1979 College of William & Mary Graduate Fellowship
1975 Madison College, Mathematics Department Award
1974 Madison College, Mathematics Department Award

ASSOCIATION MEMBERSHIPS
Virginia Mathematical Association of Two Year Colleges
American Mathematical Association of Two Year Colleges
Virginia Association of Developmental Educators
Delta Kappa Gamma Society International (Honorary society of key women educators)
- State Finance Chair, 2007-present
- Site Coordinator for Leadership Conference, 2006
- Gamma Chapter Treasurer, 2004- present
- Tidewater Coordinating Council Treasurer, 2002-present
- Gamma Chapter President, 2002-2004
- Gamma Chapter First Vice-president, 2000-2002

MANUSCRIPTS UNDER REVIEW
Peacock, M., & Landon, M. (2005). The challenge for student services: Efficient, effective reentry of the non-traditionally aged community college student. *Community College Journal of Research and Practice.*

CONFERENCE PRESENTATIONS
Peacock, M. (2008, April). *An application of supplemental instruction in a developmental math classroom.* Paper presented at New Horizons Conference, Roanoke, VA.

Peacock, M. (2005, October). *Supplemental instruction: An application to the developmental mathematics classroom.* Paper presented at the Virginia Association of Developmental Educators, Virginia Beach, VA.

Peacock, M. (2005, April). *Supplemental instruction: An application to the developmental mathematics classroom.* Paper presented at the New Horizons Conference, Roanoke, VA.

Peacock, M. (1988). *Utilizing learning styles in developmental mathematics.* Paper presented at the Virginia Association of Developmental Educators. Virginia Beach, VA.

Peacock, M. (1981). *A collaborative effort between nursing and mathematics to improve nursing students' mathematics skills.* Paper presented at FDNE. Chesapeake, VA.

INTERNSHIP
January 2006 to May 2006
Special Assistant to the Provost
Portsmouth Campus of Tidewater Community College

PROFESSIONAL EXPERIENCE
August 2006 to present
Dean of Business, Social Sciences, Public Services, and Technology
Norfolk Campus of Tidewater Community College

Formulated new certificate program in Dental Assisting in partnership with American Red Cross chapter in Norfolk, VA. Formed advisory board of local dentists and dental professionals to outline curriculum.

Formulated new AAS degree program in Human Services. Formed advisory board of local human services professionals.

Partnered with the Urban League to host the Summer Computer Camp for disadvantaged youth.

Partnered with the TIFSEA/ACF to host the Spring 2008 Salon and Showdown.

August 1980 to August 2006
Associate Professor of Mathematics at Tidewater Community College

Classroom teacher at all levels of developmental and transfer math
Assistant Division Chair for Mathematics (1981-82, 1987-89, 1997-present)
Member of President's Planning & Advisory Council, 2004-2005, 2005-2006
Chair of Math Focus Team that visited colleges in Houston and Austin, TX, 2001
Member of national team that set CLEP standards for Precalculus, 2001
Chair of Human Resources Committee of Governance Committee, 1995-96
Project Director of Two Eisenhower Grants, 1992-93 & 1993-94
Chair of Allocation of Resources Committee for Self-Study, 1992
Chair of Student Retention Committee, 1991-92
Chair of Allocation of Resources Committee for Institutional Audit, 1991-92
Faculty Advisory Committee to develop PhD at George Mason University, 1987
Summer Institute on College Teaching at William & Mary, 1987

1975-1979
Math Teacher at Deep Creek High School, Chesapeake Schools

Classroom teacher in general math, algebra I & II, and geometry.
Club advisor to National Honor Society and Cheerleading.
Task Force on General Mathematics Objectives.

COMMUNITY SERVICE

Active Member of Sweethaven Baptist Church, Portsmouth, Virginia
Nursery Worker
Sunday School Teacher for Pre-Primary Class
Member of Friends of Portsmouth Public Library
Former member of Portsmouth school PTAs with offices of president, secretary, and many committee chairmanships, 1987-2003
Former member of Churchland Soccer League Board, Vice-president, 1992-1995
American Cancer Society volunteer, 1986-1992
American Heart Association volunteer, 2007-present