CHAPTER II

Review of The Literature

This section presents a conceptual framework for the study and relevant research with a thematic review of the pertinent literature on student attitudes toward mathematics in the community college. The major themes that have emerged on the subject are the nature of attitudes toward mathematics, background of developmental mathematics, assessment of student basic skills in mathematics, placement of students in the developmental mathematics courses in the community college, student demographics, and student outcomes.

Nature of Attitudes

According to Morris (1996), an attitude is a relatively stable organization of beliefs, feelings, and tendencies toward something, that is, the attitude object. Attitudes can predict behavior and attitudes are acquired through learning and then developed through experience (Morris, 1996).

Lefton (1997) views attitudes as long-lasting patterns of feelings and beliefs about other people, ideas or objects that are based in a person's past experiences and shape their future behavior. These attitudes are usually evaluative and serve certain functions, such as guiding new behaviors and helping the individual interpret the world efficiently (Eagly & Chaiken, 1993).

Lefton (1997) stressed that attitudes have three dimensions, which are cognitive, emotional and behavioral. Each dimension serves a specific function. The cognitive dimension of an attitude consists of thoughts and beliefs. The emotional dimension of an attitude involves evaluative feelings, such as like or dislike (Abelson, 1988). The behavioral dimension of an attitude determines how people actually show their beliefs and evaluative feelings (Eagly, 1992).

Attitudes about mathematics are important factors in student decisions to enroll in mathematics courses and student attitudes toward mathematics affects these decisions. Students who have positive feelings about mathematics exert more effort, spend
more time on mathematics tasks, and are more effective learners than students with poor attitudes (Ma and Kishor, 1997).

Research Studies Related To Attitudes Toward Mathematics.

Bershinsky (1993) conducted a study, which involved 45 developmental mathematics students in mathematics courses offered by Laramie County Community College at the University of Wyoming. The purpose of the study was to identify the demographic, attitudinal, and achievement variables that are important in predicting student outcomes in developmental mathematics courses at the University of Wyoming. The following demographic variables were selected as potential discriminators (a) age, (b) gender, (c) marital status, (d) financial aid status, (e) employment status, and (f) handicapping conditions. Attitudinal variables in the study included the students' feelings about school and self, and feelings about mathematics. The dependent variables included (a) years of high school mathematics, (b) high school grade point average, (c) years since taking any math course, (d) high school diploma or GED, (e) years out of high school, (f) ACT/Math or SAT/math score, (g) number of college credits earned, (h) college credit attempted during the current semester, and (i) college grade point average. Student outcome at the end of the developmental mathematics course was the criterion variable in the study and was classified as membership in one of three groups: (a) a successful completer, (b) an unsuccessful completer, and (c) a non-completer. The findings indicated that the attitude and demographic predictor variables most consistently correlated with the discriminate functions of outcome included feelings about school and self, feelings about math, marital status, and years of high school math. Outcomes for developmental students were best predicted by their feelings about school, self, and mathematics.
Bassarear (1991) concluded that, in general, affective variables such as attitudes and beliefs are not powerful predictors of performance in a mathematics course. He suggests that there are a number of other possible causes for the low correlations, such as developmental changes in the student’s attitudes toward and beliefs about mathematics, and instability and inconsistency of attitudes in many students. This study also revealed that another explanation for these low correlations between attitude and achievement may be that attitude influences achievement in different ways for different types of students, for example, males and females or students of different ability.

Stage and Kloosterman (1991) explored the relationships between ability, attitudes (beliefs) about mathematics and achievement in developmental mathematics at a public research university in the Midwest. The 68 students in this study were enrolled in one of four sections of a college developmental mathematics course for the spring semester. The purpose of the study was designed to measure college students’ beliefs about mathematics and to identify the relationships between those beliefs and achievement in the developmental mathematics classroom. The results of the study indicated that (a) the students had a poor conception of the nature of mathematics and their own ability to perform in a mathematics course, (b) male and female students did not differ significantly in their beliefs about mathematics, and (c) beliefs about mathematics were more strongly related to final grades for women than for men.

Cox (1993) conducted a study to determine to what extent basic mathematics performance on the part of at-risk community college students can be predicted from norm and criterion referenced assessment results coupled with demographic information. The prediction variables for this study were student's age, sex, race, educational goals, class attendance, mathematics attitude score, assessment scores in mathematics, and criterion referenced mathematics scores. Completion of the Basic Mathematics course in this study was the quantifiable dependent variable illustrated by the grade of the student. The results indicated older students generally outperformed younger students, and female students outperformed male students in both age groups. Further, the variables of age and gender were significant in the prediction of
successful or non-successful achievement in the Basic Mathematics class. The variables of race and attitude toward mathematics were not significantly related to successful or nonsuccessful achievement.

**Aiken Attitude Towards Mathematics Survey.**

One of the more commonly used scales designed to measure the attitudes toward mathematics is the Mathematics Attitude Scale (Aiken, 1976) which measures general attitudes toward mathematics. The items of the Mathematics Attitude Scale cover a variety of affective aspects, such as like/dislike.

The Aiken Math Attitude Scale (AMAS) utilizes a Likert-type format and measures attitudes related to learning mathematics (Aiken, 1976). The AMAS was selected to be used in this study because it has previously been used in a college environment, administered to first year college students, and this scale produces numbers that can be analyzed statistically (Aiken, 1988).

Some studies shows that attitudes about mathematics are important factors in student decisions to enroll in mathematics courses. Reyes (1981) found that students who have positive attitudes about mathematics exert more effort, spend more time on tasks, and are more effective learners than students with negative attitudes. These attitudes towards mathematics are important factors to consider in mathematics enrollment decisions.

Attitudes have been defined in a variety of ways. For this study, attitudes are a learned tendency or predisposition to respond in a consistently negative or positive manner to mathematics that are indicated by Aiken's (1976) Math Attitude Scale.

**Maryland Developmental Mathematics**

The movement to return to the basics of education brought tougher standards and proficiency test to Maryland high schools in the 1970's (Maryland Higher Education Commission, 1997) and at the same time the Maryland Statewide Plan for Postsecondary Education assigned a large measure of the responsibility for developmental education to the community colleges (State Board for Community Colleges, 1990).
In 1987, the Committee on the Future of Community Colleges in Maryland and the State Board for Community Colleges published the Blueprint for Quality (Stage and Kloosterman, 1995), a document which strongly recommended strengthening the community college system by expanding the statewide information system to include data about developmental students and their performance at the college level.

In 1989, six community colleges participated in a pilot study to add selected data about developmental student characteristics to their annual report to the State Board for Community Colleges on student characteristics (State Board for Community Colleges, 1990). The results of the study concluded that policies and procedures at the community college vary in areas of assessment, placement and enrollment in developmental courses. To manage and interpret the new data on developmental students the Developmental Education Association of Maryland in 1990 developed a survey with the purposes to help interpret the variability among colleges, to provide information to examine developmental programs, to identify areas in which developmental programs at Maryland community colleges are similar and different and to compare Maryland community college data with data from the Southern Regional Education Board (SREB) (State Board for Community Colleges, 1990).

*Studies Related to Developmental Mathematics Outcomes.*

Faro-Schroeder (1995) conducted a study to determine which factors can predict students' academic success in a community college developmental mathematics course. The study included 150 students of the 812 enrolled in developmental mathematics classes during the Fall of 1993 and Spring of 1994 at John A. Logan College. The dependent variable was the math grade for the developmental course. Independent variables included the developmental course, prerequisite course, attendance, class level, Grade Point Average (GPA), and the mathematics placement examination. The level of significance was set at .05 to test the hypotheses. The findings indicated that the best predictor of the final grade in the developmental mathematics course was attendance. Regular attendance appeared to be the best predictor of success. Variables associated with GPA, class level and prerequisite course taking patterns were not significant predictors. The study recommended required placement testing and an attendance policy for students in
Seybert (1992) conducted a study at Johnson County Community College in Kansas on the effectiveness of the college's mathematics courses. The study examined the developmental students' pre- and post-semester assessment test scores, course grade, academic progress, and scores on standardized assessment tests taken before and after the developmental course. The population of this study included 1,026 students enrolled in mathematics between the fall of 1986 and the fall of 1990. The study was designed to assess the outcomes and effectiveness of developmental mathematics courses at Johnson County Community College. The findings indicated that: (a) small but statistically significant, positive correlation was obtained between pre- and post-semester assessment scores and grades in developmental mathematics courses, and (b) course completion rates in developmental mathematics were less than 40 percent in some of the courses.

Placement In Developmental Mathematics at PGCC.

The process of placement is to determine where students belong within a sequence of courses and is the foundation on which a developmental mathematics program rests, according to Akst and Hirsch (1991). This is particularly true in mathematics, with its hierarchical and carefully delineated course content, noted Akst and Hirsch (1991).

Developmental mathematics literature provides evidence that mathematics placement standards vary significantly from college to college (Akst and Hirsch, 1991). A regional survey of several hundred educational institutions in the American Southeast documented a large number and variety of tests utilized which measure different abilities and skills (Abraham, 1992). This specific survey found significantly divergent cut scores, the standards used by colleges to make student placement decisions, indicating a wide range of placement criteria. Variation in cut scores stems from a lack of consensus as to how these cut scores should be set and which particular variables to maximize or minimize (Abraham, 1992).
The consequences of misplacement, especially in mathematics, can be devastating for the student, according to Akst and Hirsh (1991). Some colleges leave the final decision to the student, while other colleges take a mandatory approach. Lewenthal (1981) described four models of mandatory placement: self assessment, in which students are provided with take-home tests and then decide the course in which they should enroll; advisement, in which counselors make a recommendation to students as to the most appropriate course; mandatory placement, in which a placement unit makes course assignments that are binding on the student possibly allowing borderline students to choose between alternatives; and modified mandatory placement, in which the recommendation is taken as binding unless the student obtains a waiver from a designated advisor.

Various observers over the years have supported mandatory placement. Sworder (1986) observed that ill-prepared and ill-informed students often make poor academic choices. Akst and Ryzewic (1985) suggested that mandatory placement may reflect a distrust of student decision-making and judgment rather than a sense of institutional commitment. More recently, Akst and Hirsch (1991) suggested that a community college which chooses to make its placement decisions mandatory has a particular obligation to establish the validity of its placement procedures through validity studies that usually include multiple regression or similar analysis. These analyses use one or more of the following dependent variables: grade point average, persistence, and performance in college level math courses (McFadden, 1986; Maxwell, 1988). In these studies, correlations were usually significant, but not high, since performance based upon these measures can be influenced by many factors including the student's ability, previous achievement, motivation, finances, health, overall schedule, and preferred learning style (Dennis, 1983; Ma and Kishor, 1997).

Results in a study conducted by the New Jersey Basic Skills Council (1988) also supported the position that mandatory placement is effective. A state survey found that many colleges with mandatory placement reported comparable persistence, math grades, and grade point averages for developmental completers and nondevelopmental students.
A study by Hoelzle (1988) to some degree dismantles the opposition to mandatory placement. That study examined a nonmandatory math placement system in a two year college, and found that over 70 percent of students eventually enrolled in the developmental mathematics courses recommended by counselors and advisors.

Students seeking enrollment in credit courses for the first time at Prince George's Community College are required to demonstrate basic academic skills proficiency in mathematics through placement testing or through completing developmental courses in mathematics (Catalog 1996-1998).

Basic academic skills placement testing for new students is completed after the admissions application is submitted, but before course registration. Following the placement test, students meet with counselors or advisors to discuss the examination results, major curriculum and, if necessary, developmental course requirements. In situations where the basic academic skills of a student, which are measured by the placement test, do not meet the minimum mathematics standards as established by the mathematics instructional department, successful completion of prescribed developmental courses are mandatory before enrolling in credit courses (Catalog 1998-2000).

Basic Arithmetic Course.

The developmental mathematics course Basic Arithmetic (DVM001), offered through the Developmental Education department at Prince George's Community College, is a developmental course taught by both full-time and adjunct faculty members. In the Fall 1997 semester, 19 sections were offered with an expected enrollment of approximately 300 students.

The course description, grade requirements, support services and class assignments are listed in the Fall 1997 departmental Basic Arithmetic course syllabus. Course objectives described are to develop the student's basic arithmetic skills using whole numbers, fractions, decimals, and percents as well as the use of the scientific calculator, study skills, vocabulary, estimating, and problem solving (Catalog 1996-98).
Basic Arithmetic (DVM001) is a four credit hour equivalent, noncredit course, with classes offered during the semester for 16 weeks. The content of the course consists of nine topics that correspond with the chapters in the required textbook, the second edition of Essential Mathematics by Beavers (1995). The topics cover whole numbers, fractions, decimals, problem solving, percent, number sense and calculator skills. This course is graded on a passing or not passing (F grade) basis. To earn a grade of P (pass) for the course, the requirements are to achieve an average score of 70 percent or higher on tests and required assignments. (Catalog, 1996-98).

Developmental mathematics in the community college has emerged with tough standards of assessment and placement. Maryland community colleges have developed policies for assessing and placing students in developmental mathematics courses, utilized placement tests to measure basic skills levels of entering students, and developed standards for exiting developmental mathematics courses.

*The Community College.*

In the twentieth century, the community college emerged as a new approach to higher education. Originally, the purpose of the community college was to provide the first two years of baccalaureate programs, an additional step beyond high school noted Cohen and Brawer (1989). More recently, the emphasis has focused on occupational offerings at the certificate and associate degree levels as well as a wide range of community service activities (Callan, 1997). Community colleges emphasize instructional excellence rather than research. These educational institutions of higher education are student oriented along with strong supportive counseling and guidance (Callan, 1997).

Growth in the community college over the past four decades helped to bring higher education closer to each citizen in the community. Education in the community college is flexible and open; therefore, learning experiences are formal and informal, credit and noncredit, as well as inside and outside of the classrooms (Callan, 1997).

Each community college is as unique as the communities they serve. The common element of the community college is the educational commitment to their community and students.
Maryland Community Colleges.

Discussions on the community college concept in Maryland were first reported in the 1931 Shriver Commission report. The purpose of the report was to provide funds to State-aided community colleges which would relieve the State University of some of the many students in the freshman and sophomore years, according to Pesci and Novak (1965). The need to make higher education accessible to veterans who needed to acquire vocational and technical education following World War II started the movement to establish locally controlled community colleges in Maryland (Cohen & Brawer, 1989).

The establishment of two year colleges to meet the increasing enrollment demands during this era was approved by the State Board of Education (Maryland State Department Of Higher Education, 1996).

A series of Maryland Statewide education commissions from 1947 onward consistently supported the expansion of the Maryland Community College System (Maryland Commission of Higher Education, 1996).

In 1955, the Governor’s Commission to study the needs of Higher Education in Maryland (Pullen Commission) recommended the establishment of additional locally supported and locally controlled public community colleges according to the Maryland State Department of Education (1968). Within six years after publication of the Pullen Commission report, eight public community colleges were established. Prince George’s Community College was one of those educational institutions established during this period (Maryland State Department of Education, 1996).

All Maryland community colleges have written policies and procedures to assess and place entering students with low academic skills in developmental courses (McClinton and McKusick, 1991). The colleges differ in their placement test used for mathematics with standardized tests and in house tests developed by faculty (McClinton and McKusick, 1991). Even though there exists this variability, the colleges are similar in the standards used to place students in developmental mathematics courses and require some type of exit test which all students must pass in order to complete developmental mathematics coursework (McClinton and McKusick, 1991).
Prince George's Community College, located in Largo, Maryland was founded in 1958. Classes were conducted at Suitland Senior High School with an initial enrollment of 185 students (Catalog, 1996-1998). In 1972, the Developmental Education Department was started at Prince George's Community College to meet the needs of the underprepared students in the areas of reading, writing, and mathematics (Catalog, 1996-1998).

The primary educational goal of Prince George's Community College is to provide quality education to the citizens of Prince George's County. The institution provides educational opportunities to a highly diverse student population through an open door admission policy (Catalog, 1996-1998).

The establishment and explosive growth of the community college over the past three decades has helped to make higher education available to every citizen. In Maryland, Prince George's Community College responds to the needs of the student population and surrounding environment by offering occupational education to develop skills for credit and noncredit. The courses are designed to prepare students to enter the work force, develop career skills, and to pursue further education at four year institutions.

Student Demographics.

The literature contains several studies over the last three decades on the demographic variables of students enrolled in mathematics (Shoenecker, 1996; Hyde, Fennema & Ryan, 1990; Bleyer, 1980; and Aiken, 1976). The selected demographic variables for this research study include gender, race, age, examination score, full or part-time status and final grade.

Gender.

Gender differences in mathematical performance appeared to be decreasing over the high school years (Cox, 1993). The Southern Regional Educational Board (2000) reported that gender differences in enrollment in community college developmental education courses are small and 32 percent are female students. In Maryland community colleges, 49 percent of women needed developmental mathematics courses while only 44 percent of men needed developmental mathematics reported the Maryland Higher Education Commission (1996). Prince George's Community College reported that gender differences, whether a student was male or female, had no significant bearing on the likelihood of a student taking a developmental course (McCoy, 1991).
Ethnicity.

Community colleges are experiencing a growth in the diverse population of entering students across the nation. Of the 11.1 million students in public higher education, about 5.3 million students are in the community colleges (Chronicle of Higher Education, 1996 p. 17). Community colleges enroll about half of the students in higher education who are from ethnic or minority backgrounds (American Association of Community Colleges, 1997). Students graduating from high school and planning to attend college take proficiency examinations to determine their preparedness for college level work. The Department of Education (1992) reported that among high school seniors planning to enroll in college, both Asian/Pacific Islanders and whites scored higher on mathematics proficiency tests than Hispanics, Native Americans, and African Americans. When students lack a firm understanding of mathematics upon leaving high school, they are at a disadvantage when trying to master the mathematics concepts and course material in college (Smith, 1996).

Age.

Many Maryland students emerge yearly from the secondary schools underprepared to perform in mathematics courses at the college level. Nearly 60 percent of all new high school graduates who entered a community college in the state of Maryland were underprepared, when entering college and various major fields of study (American Association of Community Colleges, 1997). The disadvantage affects the career choices when mathematics proficiency is involved.

Student Outcomes.

To effectively study student outcomes, the best modes for research design, according to Akst and Ryzewic (1985), used multiple indicators such as pretest and posttest, final grades, course completion rates, grade point average, and persistence. The student demographic variability as well as the institution standards, programs, and placement policies have resulted in no generally accepted model for assessing developmental mathematics outcomes (Ma, Xin & Kishor, 1997). Several meta-analyses research studies found that an individual group pretest/posttest is the most commonly used design for assessing developmental education programs (Ma, Xin & Kishor, 1997).
This research study uses the pretest and posttest of attitudes towards mathematics, the placement test and final examination test grade as well as the final course grade to assess the student outcome in the DVM001 Basic Arithmetic course.

Grades.

Student performance in developmental mathematics constitutes a fundamental learning outcome (Office of Institutional Research, 1997). The final examination score is the assessment that determines the performance level of the student. The course faculty member evaluates the performance of the student through examinations. Successful course completion is a useful indicator to determine progress in a course and a curriculum (Office of Institutional Research and Analysis, 1997).

Intervention and Retention.

The problem of retention, especially in developmental education courses, has caused concern at the community college. The Maryland Higher Education Commission (1991) reported that 100 percent of the community colleges in the state of Maryland had programs for student retention and monitoring systems in place to report the outcomes of students in developmental education. Student retention and satisfaction with the college experience are very important to community colleges.

According to Umoh (1994), retention, student satisfaction, and student success appear to improve when retention efforts are directed toward integrating the students' total educational experiences. Umoh (1994) reported that while the campus support services affects all students' decisions to stay in or drop out of school, it sometimes affects developmental education students even more. The results of research studies indicated that retention of students in developmental mathematics is a complex issue that seldom has a single cause but involves the interaction of different variables (Tinto, 1987; Umoh, 1994). Identified variables, in the studies, included factors related to student characteristics and student institutional interactions, performance, attitude, student support services offered, student involvement, and sense of belonging that results from institution and student interaction (Umoh, Eddy & Spaulding, 1994).

Umoh, Eddy, & Spaulding (1994) conducted a study to examine the relationship between several variables identified through retention research and students in community
college developmental mathematics courses. The purpose of the study was to identify and describe factors related to student retention and provide data for understanding retention in developmental education mathematics programs. The study focused on the following factors: (a) age, (b) gender, (c) parents’ education, (d) grade point average (GPA), (e) academic commitment, (f) institutional experience, (g) student academic integration, (h) placement grades, and (i) student performance. The results of the study revealed that there were no statistically significant differences among the variables. These findings parallel the findings of Bean and Metzner (1987) that age, gender, grade point average or parents' education were not statistically significant factors for student retention in developmental education mathematics courses.

Kangas (1992) initiated a program titled Gateway U (GU) at San Jose City College to assist under prepared students entering in reading, writing and mathematics developmental courses. A total of 259 students participated in the program and the success and retention rates were compared to the 796 students who were in developmental class sections that were not a part of the GU program. The program outcomes included class retention for students receiving a passing grade for GU students, which was 72 percent, as compared with 53 percent for non-GU students; 85 percent of the time GU sections had higher retention rates than non-GU sections, and 86 percent of the students in GU were minorities compared with 73 percent minorities in non-GU sections. Conclusions of this study using the Gateway U model increased the success and retention of under prepared and ethnically diverse students.

The state of Maryland has been a leader nationally in recognizing the retention of black students as a major problem according to the Maryland State Board for Higher Education (1996). At most institutions in Maryland, the retention rates of black students are lower than those for white students. Each institution of higher education conducts a variety of activities and support services to increase student retention. Some of these support services include the use of predictive indicators for placement in freshmen classes, offering developmental courses for different levels of mathematics, reading, writing tutorial services in specific courses, continuous counseling services, and follow-up procedures for non-returning students. Each educational institution has a learning resource center designed to assist students who need help in basic skills and
specific courses (Maryland Higher Education Commission, 1996).

Prince George's Community College (PGCC) has a student support services program funded by a grant from the United States Department of Education. The purposes of the program are to provide the student with personal and academic support to complete their college education and to help focus on the educational and career goals, develop effective study habits and attitudes, strengthen weak areas, and reinforce student potential and talent (Student Support Services, 1998). The program services include orientation services, academic advising, financial aid advising, personal, career and academic counseling, learning skills, tutorial services and transfer to four year colleges and universities counseling services. The activities of this support program consist of counseling, tutoring, skills enrichment workshops, networking sessions to meet new students, programs to investigate careers, and a mentor program. The support services program works with the developmental education program to assist students identified as underprepared and at risk.

According to the Office of Institutional Research and Analysis (1998), studies conducted at PGCC concluded that participants in these support services programs have higher retention rates and were more likely to have a successful outcome, to graduate or transfer than students who did not receive these program support services.

One of the major challenges facing educational institutions of higher education is the large number of entering students who are underprepared and need developmental education. The area of greatest skill deficiency has been identified as mathematics with the majority of entering students underprepared for college level work. Student support services programs are in place to assist students personally and academically to achieve their goals. Prince George's Community College has faced this challenge by providing student support services and programs to assist these underprepared students with basic skill deficiencies and consequently, helping these students to achieve their goals with positive outcomes.
Summary.

The need for developmental education in mathematics is well documented. According to data from the American College Testing Program (1993), forty-four percent of entering college students need help in mathematics. The National Center for Education Statistics (1996) of the United States Department of Education published a national study which reported that approximately three-quarters of higher education institutions require students to enroll in developmental education courses based on entry level placement testing. About sixty percent of higher education institutions offer entry level testing of all entering students reported the National Association of Developmental Education, (1998).

In 1997, the National Center for Developmental Education published the results of a national study that assessed the efficacy of developmental education. The results indicated that mandatory testing and placement increased the likelihood of students successfully completing their developmental courses. In addition, success in developmental courses is related to higher academic achievement and student retention rates.

According to the Southern Regional Education Board (2001), community colleges deliver more than 60 percent of the developmental mathematics courses nationwide, the mathematical courses account for the largest share of developmental courses offered, and at the community college in the SREB states, the percentages of students who enroll in developmental mathematics ranges from 30 to 75 percent. In the state of Maryland in 1998-1999, in the community college 49 percent of students who do not take college preparatory courses in high school needed developmental mathematics when entering the community college. Finally, Prince George's Community College offers courses and services to students who need assistance to enhance their basic academic skills in mathematics.