

CHAPTER III

Methodology

This chapter presents the research methods and procedures utilized in this study, the design of the study, population, student demographics, instrumentation, data collection, and methods of data analysis are presented. The purposes of this study are to assess the relationship, if any, of the initial and exiting attitudes toward mathematics and academic outcomes for students placed in the Developmental Basic Arithmetic course.

The research questions addressed by the present study are:

1. What is the difference, if any, between the pretest and posttest attitudes toward mathematics of students placed in DVM001 Basic Arithmetic as measured by the Aiken Mathematics Attitude Survey?
 - a. Is there an attitude change between the pretest and the posttest based on age?
 - b. Is there an attitude change between the pretest and the posttest based on gender?
 - c. Is there an attitude change between the pretest and the posttest based on ethnicity?
2. What is the effect, if any, of the placement test for students enrolled in Basic Arithmetic on the final exam score, attitude pretest score, and attitude change score?
3. What is the difference between the achievers and the nonachievers in Basic Arithmetic as measured by the Aiken Attitudes Towards Mathematics Survey?
4. What is the difference between the achievers and the nonachievers in Basic Arithmetic based on the demographic variables of age, gender, and ethnicity?

Design of the Study

The population in this ex post facto study consisted of the students enrolled in day and evening classes of DVM001 Basic Arithmetic at Prince George's Community College. Statistical analyses are used to explore the relationship, if any, between the initial and exiting attitudes toward mathematics as measured by the Aiken Mathematics Attitude Survey and to explore the relationship, if any, between the placement test and the final exam, attitude pretest, and the attitude change scores. Further, statistical analyses are used to explore the differences between the achievers and nonachievers based on the demographic variables of age, gender, and ethnicity. Attitudinal variables include the positive and negative feelings of students toward mathematics. Student outcome variables included the final examination score ranging from 0 to 100 points and course grade earned at the end of the semester included P - Pass; F - Fail; Q - Quit; W - Withdrawal; in the DVM 001 Basic Arithmetic course.

The study was conducted in two phases during the fall semester at Prince George's Community College in Largo, Maryland. In the first phase, the students enrolled in the DVM 001 Basic Arithmetic course were given the Aiken Mathematics Attitude Survey pretest. At the end of the semester, the posttest of the Aiken Mathematics Attitude Survey was administered. This survey consisted of a twenty-item survey that consisted of ten positive statements and ten negative statements using the Likert format. Twenty minutes in class were provided to perform the Aiken Attitude Toward Mathematics pretest and posttest. Each student in the DVM001 Basic Arithmetic classes was assigned a number to protect his or her identity.

Population

At the beginning of the fall semester there were 329 students enrolled in the 19 sections of Developmental Mathematics Basic Arithmetic (DVM001) course at Prince George's Community College.

Demographic Characteristics

Each student enrolled at Prince George's Community College completes a registration form, which contains demographic information reported by the student. This form provides information on the name, age, gender, and ethnicity.

Age.

The age of each student was reported on the admissions application and the registration form. The year of birth was deducted from the year of the study to report the age the student enrolled in the developmental mathematics course.

Gender.

The gender data were available from the registration and student records forms. These data were reported as females and males with values assigned as 1 and 2, respectively.

Ethnicity.

Student admissions applications reported the categories of ethnic identification with numbers assigned to each classification: 1. Native American; 2. Asian, Pacific Islander; 3. Black, African American; 4. Hispanic, Spanish Speaking, and 5. White.

Birth Date.

The birth date of each student was reported on the admissions application and the registration form at the time of entrance to the community college.

The students were surveyed during the first week of the semester. The following tables show the participants who responded or data was available for these students. Missing data represent no response or no data available for that student. Table 1 shows the frequency of the number of times the students enrolled in the DVM001 course. Taking this course one time was 91.5 percent or 301 students. The students taking the course two

Table 1

Descriptive Statistics – Number of Times Taking the Course
Frequency Distribution

Number of Times Course was Taken	Frequency	Percent
1	301	91.5
2	21	6.4
3	4	1.2
Total	326	99.1
Missing Data	3	.9
Total	329	100.0

times were 6.4 percent or 21 students. Four students had enrolled in the same course 3 times or 1.2 percent. Data were not available for 3 students enrolled in the course.

The mean year of birth for the students in DVM001 Basic Arithmetic was 1972.

Table 2 shows the range of years from 1927 to 1980. Age in years in Table 3 revealed that 61.1 percent of the students were less than or equal to age 21. In the range of 22 to 29 years of age was 14 percent and 16.4 percent were 30 to 39 years of age. Further, 5.8 percent of the students were 40 to 49, and 2.7 percent were 50 years of age and above. The average age of the students was 24.5 years of age. Of the 329 students enrolled in the DVM001 Basic Arithmetic course, 66 percent or (n=216) were female and 34 percent or (n=113) were male (see Table 4).

The placement score for students enrolled in DVM001 revealed an average of 8.02 with a standard deviation of 2.2 (Table 5). The total number of students (n=292) taking the placement examination revealed a range of scores from 1 to 18. Students scoring 11 or lower out of a maximum of 42 was 98.6 percent. Four students (1.2 percent) scored over the cut off score of 12 but they decided to stay in the course.

The final exam score in Table 6 shows that a total of 234 students completed the final examination with an average of 71.65. Ninety-five students enrolled in the DVM 001 course had no final exam score, since they withdrew from the course or were absent from class on the date of the exam. The group was dichotomized into age groups, gender, and ethnicity. The range of the scores was from 8 to 96 out of a maximum of 100 points. Students age 50 and above scored higher on the final exam than the other age groups, while students less than or equal to 21 scored lower than the other groups and the total average score of 71.65. Female students scored 73.14 and the male students scored 68.03. The demographic area of ethnicity showed the Black students scored 72.17 and the Not Black students scored 66.43. The Black student final exam average of 72.17 was higher than the group average of 71.65.

Table 2

Descriptive Statistics – Year of Birth - Frequency Distribution

Year	Frequency	Percent	Cumulative Percent
1927	1	.3	.3
1929	1	.3	.6
1932	1	.3	.9
1936	1	.3	1.2
1944	2	.6	1.8
1945	2	.6	2.4
1947	2	.6	3.0
1950	1	.3	3.4
1951	3	.9	4.3
1952	2	.6	4.9
1953	3	.9	5.8
1954	2	.6	6.4
1955	2	.6	7.0
1956	1	.3	7.3
1957	3	.9	8.2
1958	4	1.2	9.5
1959	1	.3	9.8
1960	5	1.5	11.3
1961	5	1.5	12.8
1962	7	2.1	14.9
1963	5	1.5	16.5
1964	8	2.4	18.9
1965	4	1.2	20.1
1966	9	2.7	22.9
1967	7	2.1	25.0
1968	5	1.5	26.5
1969	2	.6	27.1
1970	4	1.2	28.4
1971	7	2.1	30.5
1972	4	1.2	31.7
1973	3	.9	32.6
1974	9	2.7	35.4
1975	8	2.4	37.8
1976	12	3.6	41.5
1977	30	9.1	50.6
1978	72	21.9	72.6
1979	88	26.7	99.4
1980	2	.6	
Total	328	99.7	
Missing Data	1	.3	
System Total	329	100.0	100.0

Table 3

Descriptive Statistics – Age Group
Frequency Distribution

AGE	FREQUENCY	PERCENT
Less Than or Equal to 21 Years	201	61.1
22-29	46	14.0
30-39	54	16.4
40-49	19	5.8
50 and above	9	2.7
Total	329	100.0

Table 4

Descriptive Statistics – Gender
Frequency Distribution

Gender	Frequency	Percent
Female	216	65.7
Male	113	34.3
Total	329	100.0

Table 5

Descriptive Statistics – Placement Score –Test Score First Time At College
 Frequency Distribution

Placement Score	Frequency	Percent
1	1	.3
2	2	.6
3	9	2.7
4	4	1.2
5	23	7.0
6	29	8.8
7	42	12.8
8	49	14.9
9	59	17.9
10	45	13.7
11	25	7.6
14	2	.6
18	2	.6
19	0	0
20	0	0
Total	292	88.8
Missing Data	37	11.2
Total	329	100.0

Table 6

Descriptive Statistics – Final Exam Score
 Frequency Distribution Dichotomized into Age Group, Gender, and Ethnicity

Age Group	Frequency	Mean
Less Than or Equal to 21	143	68.41
22-29	30	71.03
30-39	40	80.20
40-49	16	76.44
50 and Above	5	84.60
Total	234	71.65

Gender	Frequency	Mean
Female	166	73.14
Male	68	68.03
Total	234	71.65

Ethnicity	Frequency	Mean
Black	213	72.17
Not Black	21	66.43
Total	234	71.65

The final grade in class achieved by the students in Table 7 shows 52 percent of the students earned a passing grade of P (n= 171), 24.9 percent failed the course (n= 82), 23 percent of the students (n=76) quit, withdrew or received no grade.

In Table 8, the ethnic makeup of the students enrolled in the DVM001 Basic Arithmetic course, shows one was Native American (.3 percent), nine were Asian (2.7 percent), 301 were Black or African American (91.5 percent), seven were Hispanic (2.1 percent) and 11 were White (3.3 percent). Further, Table 8 shows the ethnicity variable was dichotomized into Black and Not Black. Over 90 percent of the students enrolled in DVM001 Basic Arithmetic were Black and 8.5 percent of the students were Not Black.

Table 7

Descriptive Statistics – Grade in Class
 Frequency Distribution

Final Grade	Frequency	Percent
N/G	2	.6
F	82	24.9
P	171	52.0
Q	21	6.4
W	53	16.1
Total	329	100.0

Key:

N/G = No grade reported

F = Fail

P = Pass

Q = Quit (Withdrawn for nonattendance)

W = Withdrawal (Student withdrew prior to the twelfth week of class)

Table 8

Descriptive Statistics – Ethnicity
 Frequency Distribution and Ethnicity dichotomized into Black and Not Black

Ethnicity	Frequency	Percent
Native American	1	.3
Asian	9	2.7
Black	301	91.5
Hispanic	7	2.1
White	11	3.3
Total	329	100.0

Ethnicity- Black and Not Black Students

Ethnicity	Frequency	Percent
Black	301	91.5
Not Black	28	8.5
Total	329	100.0

The selection of Prince George's Community College for the site of this study was based on:

1. No research study had been conducted on the Basic Arithmetic Developmental Mathematics students to determine their attitude toward mathematics.
2. The Dean of Developmental Education gave written permission to conduct the study in the developmental mathematics department.
3. The department chairperson, faculty and support staff were willing to cooperate in conducting this study.
4. The students placed in the DVM001 Basic Arithmetic course were willing to participate in this study.

Instrumentation

Prior to students' enrolling in credit courses at Prince George's Community College students are required to demonstrate proficiencies in mathematics through placement testing or developmental coursework. The Descriptive Test of Mathematics Skills (DTMS) measures the basic skill areas of mathematics and is untimed. Minimum entry standards for credit courses are established by the mathematics department. The minimum score to place into credit mathematics courses is 610 or higher. The basic arithmetic cluster consisted of thirty-five questions in the following areas:

- | | |
|-----------------------------------|-------------|
| 1. Operations with whole numbers | 7 questions |
| 2. Operations with fractions | 7 questions |
| 3. Operations with decimals | 7 questions |
| 4. Ratio, proportion, and percent | 7 questions |
| 5. Applications in word problems | 7 questions |

When student placement scores are below the departmental set standard of 610, students are recommended to the Sub-Test 1 of the Basic Mathematics Placement Test (BMPT). Students with a score of less than 12 out of a maximum score of 42 points on the BMPT and a DTMS score of 501 to 506 are placed in DVM001 Basic Arithmetic.

Reliability of the test scores of students is the extent that the students would score the same on two different forms of a test. The reliability coefficient for the Basic Arithmetic section of the Descriptive Tests of Mathematical Skills is .84 with a 2.1 standard error (DTMS, 1995).

During the first session of the DVM001 Basic Arithmetic course, Subtest 1 was administered to each student. Subtest 1 was used in conjunction with the DTMS test to confirm the need for developmental skills and identified specific chapter topic areas of the course that needed to be reviewed and mastered. Subtest 1 is designed to assess mastery of the course topic areas such as whole numbers, fractions, decimals, problem solving, percent, and the use of the scientific calculator (Appendix B). There were 42 items on this test. Students with scores of 12 and above were encouraged to enroll in the next level developmental course.

Aiken Attitude Toward Mathematics Survey

The Aiken Attitude Toward Mathematics Survey consists of 20 statements, half are positive and half are negative, using the Likert scale format. This scale was validated with college students in their first year, and takes about 20 minutes to

administer. The Aiken survey reported a test/retest reliability of .94 (Shaw & Wright, 1967).

The following values were assigned to the response options for analysis of the data: strongly disagree = 0; disagree = 1; undecided = 2; agree = 3; and strongly agree = 4. The maximum score was 80 points. Survey statements 1, 2, 6, 7, 8, 10, 12, 13, 16, and 17, on the Aiken Attitude Toward Mathematics Survey are negative items and the response options are the same but the values for the responses must be reversed when scored. The survey statements number 3, 4, 5, 9, 11, 14, 15, 18, 19, and 20 are positive items. For each student, participating in the mathematics attitude survey, the responses were totaled giving a measure of attitude toward mathematics.

Reliability.

Aiken (1996) concluded that although the reliability coefficients of attitude instruments are usually lower than those of cognitive measures, it is not unusual to find test/retest and internal consistency coefficients at levels of .80 and .90 for Likert-type scales. One reason for these high reliability coefficients is the influence of a strong general factor in what these scales are measuring. The Aiken Attitude Toward Mathematics survey is fairly homogeneous with respect to item type; therefore, an alpha coefficient was computed. Scores on Likert-type scales tend to be more reliable because the larger number of response categories on the instrument increases the variance of the scores according to Aiken (Aiken, 1996).

Validity.

Criterion related validity of an attitude survey according to Aiken (1996) is obtained by correlating scores on the instrument with other measures of the same or another variable obtained at the same time. According to Aiken (1961), scores on the attitude towards mathematics scale were found to be significantly related to final course grades of 67 females but not to the final course grades of 60 males. Final course scores on this attitude scale also predicted gains in scores from the initial to the final administration of a mathematics achievement test when training intervened. Correlation between the

placement score and the final exam score, attitude pretest score, and the attitude difference score by the demographic variables of age and gender was calculated.

Dependent Variables

Attitude Difference.

Subtracting the pretest score from the posttest score yields the change or difference in the attitude as measured by the Aiken Attitude Toward Mathematics Survey.

Final Examination Score.

The score on the final examination was reported at the end of the semester by the developmental mathematics instructor and recorded on the class roster in numerical terms of 0 to 100 points.

Final Grade.

Data related to student outcomes in DVM 001 Basic Arithmetic was retrieved from faculty records and final grade rosters. The student grade rosters provided the final course grades of P - Pass; F - Fail; Q – Quit (Withdrawn for nonattendance; and W – Withdrawal (Student voluntarily withdrew prior to the twelfth week of class.)

Summary

The population for the study consisted of 329 students enrolled in the nineteen sections of Developmental Mathematics (DVM001) Basic Arithmetic course at Prince George's Community College. The scheduled courses were offered at a variety of times during the day and evening to full-time and part-time students. These classes were offered for students deficient in basic mathematical skills. In the fall semester, two-thirds of the students entering Prince George's Community College and taking the placement test in the basic skills areas of reading, writing, and mathematics, needed remediation in at least one basic skills area (Office of Research and Analysis, 1998). Fifty-seven percent (1,585) of entering students required remediation in the basic skills area of mathematics (Office of Institutional Research and Analysis Report, 1998). Twenty-one percent of the entering students requiring remediation in mathematics were placed in the (DVM001)

Basic Arithmetic course. Over the last five years, mathematics continuously is the weakest skill area among entering students (Office of Research and Analysis, 1998).

For this study, the population consisted of the day and evening students who enrolled and completed the DVM001 Basic Arithmetic course, the Aiken Attitude Toward Mathematics pretest and posttest, and the final exam during the fall semester.

In summary, the students registering for courses completed the application and registration forms that included demographic information which was used in this research study. The faculty provided the final examination score and final grade on the student grade rosters at the end of the semester.

Data Collection Procedures

The Director of Admissions and Records granted permission to access the demographic characteristics of age, gender, and ethnicity, and the placement scores of students registered in the Fall Developmental Basic Arithmetic course (Appendix C). The withdrawal and quit data were retrieved from the final course rosters produced by the faculty members of DVM001 Basic Arithmetic classes. The Dean of Developmental Studies granted permission to conduct the research study on students enrolled in DVM001 Basic Arithmetic (Appendix A). The faculty of DVM001 Basic Arithmetic courses was orientated on the purpose of the study in order to gain their support and cooperation. Faculty members were requested to maintain and submit student records at the end of the semester containing final examination scores and final course grades.

The Aiken Attitude Toward Mathematics Survey instrument (with permission) was administered to the students enrolled in the DVM001 Basic Arithmetic course during the beginning of the Fall semester (Appendix B). First, the students were asked to read the cover sheet and instructions of the survey. Second, the students were requested to fill in their names and social security numbers if they wanted to participate in the survey. Finally, the participants were asked to complete the survey statements in twenty minutes.

The survey was then collected and placed in an envelope previously marked with the class section, class time, and name of the faculty member. Each student was given a number to protect his or her identity.

At the end of the semester, the Aiken Attitude Toward Mathematics survey instrument was administered to the students enrolled in the DVM001 Basic Arithmetic classes, again requesting their participation to complete the survey instrument. The same procedures were used since it was so efficient at the beginning of the semester.

Before registering for courses at the beginning of the semester, students entering Prince George's Community College take the placement test. This test determines the basic skill levels in areas of English, reading and mathematics. The score from the mathematics skill area is reported in this research project. This research study specifically is focused on the student scores in the mathematical skills area of the placement test. The mathematical skill area contains questions designed to test the basic skills in whole numbers, fractions, decimals, percents, and problem solving.

Data Analysis

This section presents each research question and the statistical methods used to treat the data. The analysis of the quantitative data include frequencies, a basic measure of central tendency (mean), percentile rank, and correlation. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) (Norusis, 1999) and the alpha for testing the null hypothesis set at .05 level of significance.

Research Question One - What is the difference, if any, between the pretest and posttest attitudes toward mathematics of students placed in DVM001 Basic Arithmetic as measured by the Aiken Mathematics Attitude Survey? Sub questions (a) Is there an attitude change between the pretest and the posttest based on age? (b) Is there an attitude change between the pretest and the posttest based on gender? (c) Is there an attitude change between the pretest and the posttest based on ethnicity? The responses to the

survey items for each of the twenty statements (10 positive and 10 negative statements) were strongly disagree, disagree, undecided, agree, and strongly agree. The value assigned to the responses were strongly disagree = 4, disagree = 3, undecided = 2, agree = 1, and strongly agree = 0. For the negative statements, the values were reversed; strongly disagree = 0, disagree = 1, undecided = 2, agree = 3, and strongly agree = 4. The scores of the twenty statements were summed to achieve a total score for each student. The SPSS was used to determine the frequencies, percent, mean, and standard deviation for the student responses on the Aiken Mathematics Attitude Survey pretest and posttest. Further, a paired sample t test was used to test whether the mean of the variable attitude differs between the pretest attitude and the post test attitude. The design of this study was to measure the attitude of each participant twice. That is, the pretest before the DVM001 Basic Arithmetic course and the posttest was administered after the intervention of the DVM001 Basic Arithmetic course. Data were analyzed using analysis of variance to test the effect of age, gender, and ethnicity and to determine a possible interaction between the demographic variables in respect to attitudes toward mathematics. In this analysis attitude difference toward mathematics is the dependent variable, and age, gender, and ethnicity are the independent variables.

Research Question Two – What is the effect, if any, of the placement test for students enrolled in Basic Arithmetic on the final exam score, attitude pretest score, and attitude change score? Data were analyzed by generating an intercorrelation matrix to correlate the variables with each other.

Research Question Three – What is the difference between the achievers and nonachievers in Basic Arithmetic as measured by the Aiken Attitude Towards Mathematics Survey? The data were analyzed to find the frequency, mean, and standard deviation of the final grade. One-way analysis of variance (ANOVA) was used where final grade was the dependent variable and gender and age groups of the Black Only student groups were the independent variables. Then (ANOVA) was utilized where attitude difference was the dependent variable with gender and age groups as the independent variable. The purpose

for using the Black Only student group was determined based on the data that over 90 percent of the student population of this study was Black.

Research Question Four – What is the difference between the achievers and the non-achievers in Basic Arithmetic course based on the demographic variables of age, gender, and ethnicity? The data were analyzed by utilizing chi square to determine if a relationship exists between the two variables of age and gender of those students who passed and those students who failed the course. Frequencies were tabulated of the various combinations of students who passed and students who failed based on age group and gender. A two by two contingency table was constructed to show students who passed and students who failed by age group and then by gender.

Summary

This chapter describes the methodology of the research study. The design of the study is predictive and describes the association between the Aiken Attitude Toward Mathematics pretest and posttest attitudes and the placement test, final exam score, and attitude change score in the mathematics basic arithmetic course. The participants of the study are identified, and the instrumentation and data collection procedures were described. Reliability and validity were described and presented as a vital part of this study. Each research question was addressed and included the variables and treatment of the data. Data collection procedures were outlined and the variables were identified.