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Implications of Extended College Algebra on Western Kentucky University Students

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IMPLICATIONS OF EXTENDED COLLEGE ALGEBRA ON WESTERN KENTUCKY UNIVERSITY STUDENTS

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ABSTRACT

College algebra has the highest enrollment of any mathematics course at Western Kentucky University. In an effort to increase the success rate in this course, Western Kentucky University added an extended version of college algebra to the curriculum in the fall of 1997. The extended version incorporates two days of supervised study per week in addition to traditional lectures. This study investigates the success of the extended college algebra course on achievement rates of Western Kentucky University students.

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Dr. Wanda Weidemann, my director, for her assistance and direction in the development of this study, and to Mrs. Linda Pulsinelli for allowing me to assist in her college algebra course throughout the semester and for continually offering her support and assistance whenever needed.

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INTRODUCTION

For decades, mathematics teachers have been faced with a perplexing problem: how can a teacher help the students to grasp mathematical concepts and ensure that they are practicing the skills? The majority of teachers use the strategy of assigning homework and assessing student comprehension after giving students an opportunity to ask questions in class. This has proven to be effective in some instances and unsuccessful in others. This study investigates "supervised study," a new approach to student learning and achievement in mathematics courses.

Supervised study can be defined in many different ways. For the purpose of this study, supervised study includes allowing students to work individually or in groups with two qualified individuals available to answer questions and provide direction. The students can also see teachers or other students solve problems on the board and receive instruction for using graphing calculators. This approach differs from homework because students are given specific time-on-task in which they must be working and someone is always available to answer questions. Supervised study should prevent students from putting off practicing and studying until the night before a test and keep them current on the topics being covered.

Supervised study can also help to alleviate another fear of mathematics students,

the fear that they can not do the problems. This perception may be changed by supervised study. Students are not as apprehensive, and their self-confidence increases because they know time will be allotted for them to ask questions and practice problems. The pace of the class incorporates student learning.

The purpose of this study was to examine the effects of supervised study on student achievement in a mathematics course. I conducted my research in a college algebra course with an extended component (MATH 116E). The course was a three-credit-hour course that met five days per week, whereas the traditional college algebra course (MATH 116) met only three days per week. In the new course, Monday, Wednesday, and Friday were devoted to lecturing and introducing new material, as in the regular course. Tuesday and Thursday, however, represented the extended component used for supervised study. The same instructor taught both a regular course and an extended course, covering exactly the same material in each. This study will compare achievement in both classes.

I was directly involved with the MATH 116E course by assisting the instructor in the classroom. I spent time guiding the students through problems that posed difficulty to them, graded papers, took the attendance, and encouraged the correct use of the graphing calculators.

The problem was as follows: Will students in a college algebra course that requires two days per week of additional supervised study attain a higher achievement level than students in a traditional section of the same course?

Throughout the first two months of the 1997 fall semester, grades for both the regular MATH 116 and MATH 116E were recorded. After testing the significance of the difference in ACT scores of both classes, I segregated the classes by American College Test (ACT) scores and Math Placement Exam (MPE) scores. Grouping the students according to their abilities as demonstrated on the previously stated exams presented a better comparison with which to analyze achievement. These groups of students were compared by testing the significance of the differences in their achievements over two units of study. All tests, quizzes, and homework were teacher-made achievement tests designed to measure the objectives for each unit. Also, students' attitudes toward mathematics were examined to see the students' perception of supervised study and their achievements in the class.

This study may prove to be very beneficial for the Department of Mathematics at Western Kentucky University. Since this is an experimental course, the results of this research could have a lasting effect on the University's future decisions to offer similar courses involving supervised study.

LITERATURE REVIEW

Throughout the last century, educators have been concerned with the issue of increasing achievement scores in mathematics. One major question has been, "Does supervised study improve achievement?" Few comprehensive studies have been conducted concerning supervised study versus no supervised study and its effect upon academic achievement. The lack of experimentation in this field creates difficulty in presenting accurate information concerning the benefits or downfalls of supervised study.

In-school supervised study usually contains varying degrees of three characteristics. First, researchers have experimented with lengthening the school day or shortening the time devoted to subjects or activities that are not covered in the homework to give students additional time to do homework at school. Second, the type of supervision varies from having no teacher interaction with individual students to the students interacting with each other as well as the teacher. Third, supervised study sometimes differs in how closely its content corresponds to the material assigned in the homework (Cooper 77). The latter has a dramatic effect on achievement because the supervised study may be focusing on material that is not pertinent exam information.

Often, teachers see the benefits of supervised study but do not know how to conduct it. Some teachers merely act as babysitters to keep order. If help is not provided

in a timely manner, students focus too much attention on the trial-and-error method and quickly get distracted. This sometimes results from a teacher's failure to analyze study methods and select what is best for students of different mental abilities (Strang 9). All students learn differently and prefer certain types of interactions to others. For instance, some students prefer to work individually instead of in a group setting. Trying to force students to learn in uncomfortable situations will negatively affect their achievements.

Early research in the field of supervised study is rare and often inconclusive because of the lack of accurate statistical analysis. In much of the research, data were recorded, but only the mean of the achievements of different groups was compared. No in-depth statistical analysis was performed until researchers later went back and calculated the significance of the data when the data were available. Often, the data had been discarded.

The earliest study found by this author was a 1927 study by Hagan. Very little is known about the conditions of the supervised study, but Hagan compared two pairs of sixth-grade classes and one pair of seventh-grade classes covering five subject areas. He kept records of test scores prior to the experimentation with supervised study and compared these with scores at the conclusion of the study. Although no significance tests were conducted, achievement favored supervised study in all subject areas except arithmetic fundamentals (Cooper 78).

Another early study on the effects of supervised study was conducted by Johnson in 1931. Students in sixth-grade history classes were matched according to an

intelligence test and history pretest scores. Johnson conducted the study over two units and switched the treatment of the groups after the first unit. Supervised study in this instance was documented as including teacher aid to the students. No formal significance tests were conducted by Johnson, but since raw data were included in her documentation, later calculations proved no significant differences in achievement for either of the treatment groups (Cooper 78).

Cooper states that "inconsistent and incomplete data reporting make it impossible to generate comparable effect sizes and directly synthesize the early research using the supervised study control" (81). Although this is true, after analyzing the records it was concluded that in most early studies focused on supervised studies no significant differences occurred. The few that reached significance could be explained by the element of chance and inconclusive statistical documentation. When only the means were compared, those in supervised study situations often performed better, but no group was superior to the other (Cooper 81). Strang comments that "average pupils were no better off, the superior students somewhat less well off, and that only the weaker pupils were aided" (380).

Cooper classifies any study since 1962 as recent research. In 1964, Ted Brinke conducted a study on seventh and eighth-grade math students. Students were randomly placed into either homework groups or supervised study groups. Throughout the period of investigation, students took tests on five units; each was recorded separately as well as test scores from three skill areas which were subdivisions of the overall tests. None of

the comparisons proved to be statistically significant. In general, the students in the homework classroom outperformed the supervised study classroom. Brinke then did a study to see if the results of the data analysis could have been affected by mental abilities. Brinke reported that "the general direction of mean differences indicated that homework was more effective for brighter students and supervised study was more effective for slower students" (Cooper 81-83).

The most recent studies conducted were in 1983 as class projects at Wright State University in Ohio. These studies evaluated the difference between homework and supervised study and most appropriately correspond to the research involved in this project. Each of the three studies involved made use of two classrooms. Each classroom was either assigned to homework or supervised study treatment. In all the studies, the material covered was identical. Achievement was measured by an assessment constructed by the teacher. The three subjects involved were French, English, and mathematics. Conclusions favored homework for the French and mathematics courses and supervised study for the English students (Cooper 85-86). The major difference between these studies and the research in this project is that supervised study and homework were not treated as separate entities in this project. Students were still assigned homework in both college algebra courses and expected to complete it before the next class period.

The overall analysis of all the research on supervised study suggests supervised study is beneficial for elementary students, while homework is more effective for junior

high and high school students. It is impossible to know if the duration of the treatment had an effect on the results of the study since all the studies conducted before 1980 had durations longer than 10 weeks, and all those during the 1980s were less than 10 weeks. Also, the subject matter in which the research was conducted was not a significant factor influencing achievement. The studies focusing only on mathematics-related topics, however, proved to be significant. Homework was more effective for concept learning and problem solving while supervised study was more effective for computation (Cooper 88).

There is a great lack of research in the area of supervised study as illustrated through the brevity of this literature review. The few sources that were available were outdated and were not what would ideally be labeled supervised study. Harris Cooper in his book entitled Homework had one brief chapter comparing homework to supervised study. The book was published in 1989, yet the majority of his sources for supervised study were from research conducted in the 1950s and 1960s and often by the same author. Cooper considered recent research anything since 1962, with the most recent studies consisting of unpublished student projects in 1983. This makes it even more evident that there is a lack of research and a great need for current experimentation with supervised study.

In the search for information, resources such as ERIC, InfoTrac, the Internet, library holdings, and other reference materials were explored. All of these searches presented minimal results on the topic of supervised study yet presented much material

on some related but not highly relevant topics. Some topics that could possibly have a substantial effect on the success or failure of supervised study are time-on-task, homework, parental involvement, and cooperative learning. Each of these topics presented an array of research information that was analyzed for its relevancy to supervised study.

Much research was found concerning the topic of time-on-task. Seifert found that significant positive relationships were found between achievement gain and the amount of time students spent on tasks related to the learning objective. Significant negative relationships were found between academic gain and directed study strategy, the amount of time students spend on tasks not related to the learning objective, and students' total engaged time--including waiting for help. Achievement gains for individual classrooms were significantly related to minutes of time-on-task per classroom (45). An observational study by Veenman found time-on-task for mathematics classes was lower for mixed-age classes. However, no significant differences in achievement test scores were found (21). Erik Roelofs discovered in 1995 that time-on-task levels were higher in homogeneous rather than heterogeneous classes (23). The search for related topics of supervised study produced much more information concerning time-on-task (Rossmiller 1986, Lomax 1979, Prater 1992, Karweit 1980, West 1994, Latham 1985). Although time-on-task could have a slight effect on the success of supervised study, this information needs no further explanation because it is only marginally pertinent to the subject at hand.

Research on homework was another area that produced a great deal of information that was of little relevance to supervised study. It is true, however, that the amount of time spent on homework outside the classroom can improve the effectiveness of supervised study within the classroom. Many of the sources (Wiebe 1982, Easton 1990, Anderson 1986, Cooper 1994, Friesen 1978) revealed the effect of homework on overall achievement. A research report in 1986 indicated a positive relationship between the amount of time spent on homework and reading achievement (Anderson and Bernice 17). According to Paschal, Weinstein, and Walberg, some educators argue that homework is unwholesome, professionally unsupervised, and allows children to practice making mistakes. Because of the debate over homework, the amount of homework assigned has varied throughout the last century (97). To analyze the effects of homework on achievement, a vast information search was conducted that yielded the following results:

---United States students score lower than students in other countries because they spend less time studying in and out of school.

---Homework that is graded and commented upon benefits learning (Paschal, Weinstein and Walberg 104).

Another study analyzing 20,364 high school students concluded the following:

> The implications of this and past research seem clear: increased homework time results in higher achievement, as measured by grades, for all levels of ability. Homework also seems to have compensatory effects; students of lower ability can achieve grades commensurate with their brighter peers through increased study. In these times of concern over the "failure" of the public schools, it would seem that increased homework time is a partial answer to the dilemma of how to improve education. (Keith 252)

Aside from the improvement in academic achievement, homework can have other benefits. It teaches good independent study habits as well as fosters effort and concentration (Keith 9). In addition, "supervised study at school might reasonably be expected to be at least as effective as unsupervised home study" (Ziegler 58).

Parental involvement is another factor that affects student achievement. Originally, it was believed that parental involvement and home stimulation accounted for 50% of the variance in school achievement (Paschal, Weinstein and Walberg 97). More recent studies, however, have shown that parental involvement has no direct effect on academic achievement. The discrepancy between the past and present research is somewhat accounted for by the additional control of such variables as family background. Parental involvement does have an indirect effect by influencing the amount of time students spend on homework. It seems very reasonable that "parents should have more influence on the behavior of their elementary-school-age than their secondary-school-age children, and therefore, that there may well be differential effects for parental involvement, depending on the age and grade of the students studied" (Keith, Reimers, Fehrmann, Pottebaum and Aubey 378).

One new, innovative idea to encourage homework participation and cooperative learning is called "Homework Partners." At the beginning of each chapter, mathematical ability and geographic location are used for assigning partners. Switching partners after each chapter gives the students experience working with different partners with varying

abilities. Students are expected to complete the entire homework assignment and then telephone their partner to compare answers and help each other where necessary. Some difficulties of this practice include slower students requiring too much explanation from their partner and unmotivated students neglecting to do the assignments. Benefits of the homework partners idea are abundant. Homework is completed consistently, and the quality of work is higher. It takes less time to review the homework in class because students have already reviewed the work and corrected many of their mistakes. As homework achievement rises, the self-confidence of the students increases, making them less hesitant to ask questions and discuss problems in class. Finally, homework partners builds a sense of responsibility and promotes communication and cooperation skills (Kaplan 168-69). Cooperative learning and group work have proven to be very effective. Students learn a concept more deeply when they are able to teach others.

Research done by Uri Treisman on the Mathematics Workshop Program developed in 1977 has affected the way teachers conduct their classrooms.

> The basic premise of the workshop is simple: besides regular classroom lectures and homework, students spend extra in-class hours each week working exceptionally difficult problems. Faculty or workshop leaders act as facilitators rather than as lecturers, and the focus of the extra class time is to increase the interaction among students and between faculty and students. The students work together in groups of 5-7, and are encouraged to discuss the problems and to give each other instruction on possible solutions. (Seal 8)

The students enrolled in this workshop have significantly outperformed nonworkshop students and have significantly more out-of-class contact with the instructors (Seal 8). Four semesters after the introduction of a similar program in Intermediate Algebra at

Lexington Community College in Lexington, Kentucky, students who had the same Math ACT scores achieved a 2.4 average final grade as compared to 1.5 for those not enrolled in the program. More importantly, this achievement carried over into the College Algebra Course. Those students previously enrolled in the workshop program achieved a 2.4, while the students who were enrolled in the regular course received a 1.5. Also, the alumni of the workshop program had a much higher rate of passing in College Algebra than the alumni of the regular course-82% to 51% (ARSI College 1).

Supervised study is a fairly unresearched topic that presents some conflicting data. This makes current research even more valuable in the quest for better and more successful ways to teach mathematics.

SAMPLE

The sample for this study consisted of students enrolled in two college algebra courses during the 1997 fall semester. The courses were taught at Western Kentucky University, located in Bowling Green, Kentucky. One of the college algebra courses, labeled MATH 116E, is an extended version incorporating two days of supervised study per week into the curriculum. The other college algebra course, labeled MATH 116, is a traditional section of college algebra. The two algebra courses were chosen for the study because they were both taught by the same instructor. The regular MATH 116 class met in the morning while the MATH 116E met in the afternoon. Forty-five students were enrolled in MATH 116; thirty-five students were enrolled in MATH 116E. Five students either dropped, withdrew, or stopped attending MATH 116E before the study was completed, so data analysis was performed on the remaining thirty students.

Students enrolled in MATH 116E must have met one of the following requirements if they were transferred from a regular MATH 116 course:

---that they had a math ACT score below 17 (but Math Placement Exam greater than or equal to14) or Math Placement Exam score below 14 (but Math ACT greater than or equal to 22).

---that they were repeating MATH 116 to improve a grade of W, D, or F.

---that they had completed MATH 100 (Intermediate Algebra) with a grade of C (not A or B).

---that they completed their previous algebra course several years in the past.

---that they were concerned about keeping up with MATH 116 homework.

If students met any of these requirements, they were eligible to enroll in MATH 116E. The experimental MATH 116E course was also made available in the following way to students who initially were enrolled in MATH 100:

---that they had a Math Placement Exam score of 13 and a Math ACT score of 19 (or better).

Instructors encouraged students who met these criteria to consider enrolling in one of the three MATH 116E courses experimentally offered at Western Kentucky University.

PROCEDURES

Math 116 and Math 116E were evaluated over a series of ten quizzes and two exams. Because of the requirements for enrolling in Math 116E, it was essential to test for a significant difference in the ACT and Math Placement Exam (MPE) scores in the two classes. The null hypothesis stated that no significant difference existed between the means of the ACT and MPE scores. The t-test was used to test the difference between the means of the two independent groups, first focusing on ACT scores and then MPE scores.

After the t-test for the difference in the means of the ACT and MPE scores in the two independent classes, a t-test was conducted to test for a significant difference in the overall point scores between the two classes. The grading scale was on the point system, so the total points for each student was the sum of the points scored on each of the ten quizzes and two tests. Percentage scores may differ slightly from those at the end of the semester because the semester was not completed when this study was conducted.

The instructor who taught the sections of Math 116 and Math 116E used for analysis in this study taught two sections of Math 116 last semester before Math 116E was created. To compare class achievement between all college algebra students under the same instructor this semester (Math 116 and Math 116E) to achievement of college

algebra students last semester, first a t-test was conducted to determine whether a significant difference existed between ACT and MPE scores. If a significant difference existed, there would have been no basis for further investigation. Since there was no significant difference between last semester and the current semester's ACT and MPE scores, then another t-test was conducted to observe whether a significant difference existed between student achievement in the two semesters. This provided further evidence to the success or lack of success of the extended college algebra course.

Also, a comparison was done to analyze the success of Math 116E students relative to Math 116 students of the previous semester who would have qualified for the extended version of college algebra. To examine whether the two groups of students were comparable, a t-test determined the significance of the difference of the two means using ACT and MPE scores. Since no significant difference existed, a t-test was conducted to determine whether a significant difference existed between grades achieved by the Math 116E students and those students who would have qualified for Math 116E in the previous semester had the course been offered.

Since ACT scores and MPE scores were used as the decision-making factor to place a particular student in a particular class, it was valid to see if a correlation existed between either ACT scores and achievement and MPE scores and achievement. Correlation is a measure, on a scale of negative one to one, of how close two variables are to being linearly related.

A brief questionnaire was developed to gain student input on class achievement

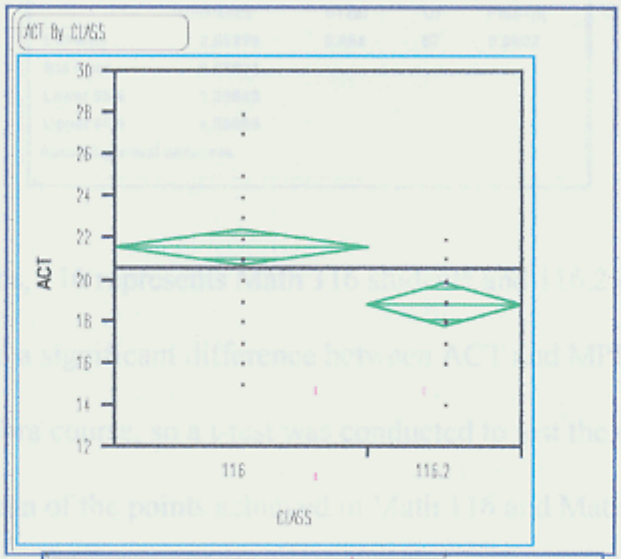
and classroom behavior. The questionnaire consisted of six statements, most of which required the student to circle the appropriate response. Instructions and explanations of the nature of the questionnaire were given orally, and then the questionnaires were distributed. After allowing ample time for the students to answer the questions, the questionnaires were collected. Percentages were computed in the analysis of the results. Both the questionnaire and the percentages appear in the appendix.

DATA ANALYSIS

The results of the t-test for the difference in the means of the ACT and MPE scores of the Math 116E students versus the Math 116 students appear in Table 1 and Table 2. The label PROB>[t] is given to the p value in the test table to indicate that this is the probability of getting an even greater absolute t statistic. This is the significance level. A p value less than .05 is regarded as significant.

TABLE 1

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN ACT SCORES FOR MATH 116 AND MATH 116E



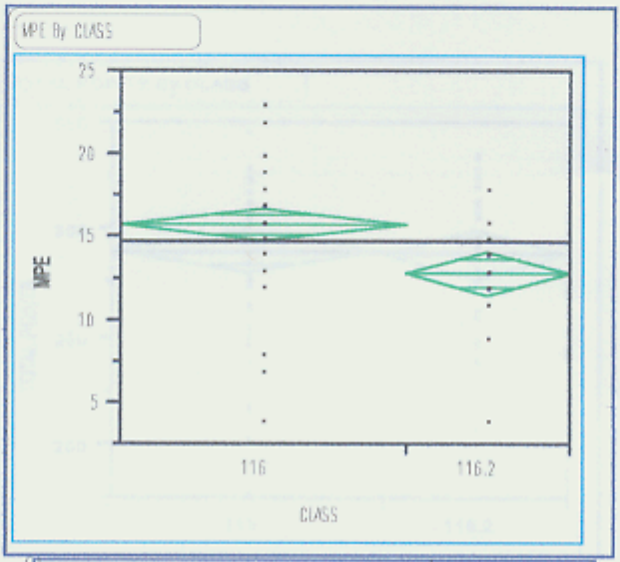
t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	2.74329	3.916	67	0.0002
Std Error	0.70059			
Lower 95%	1.34509			
Upper 95%	4.14150			

Assuming equal variances

TABLE 2

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN MPE SCORES FOR MATH 116 AND MATH 116E



t-Test

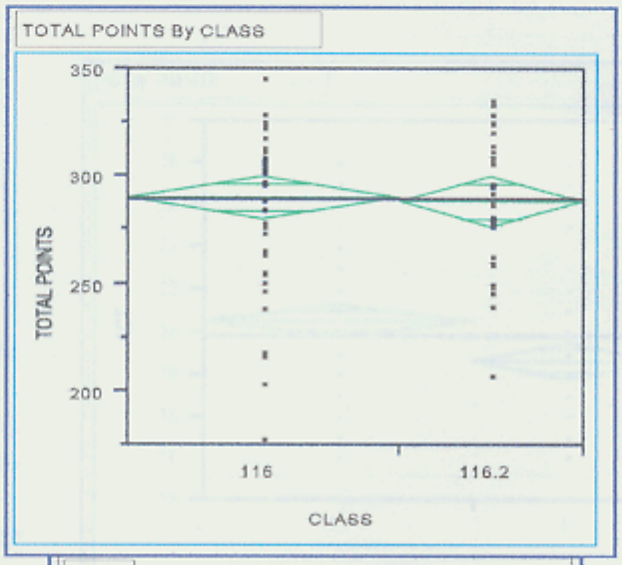
	Difference	t-Test	DF	Prob>|t|
Estimate	2.89273	3.484	67	0.0009
Std Error	0.83031			
Lower 95%	1.23543			
Upper 95%	4.55003			

Assuming equal variances

On the graphs, 116 represents Math 116 students and 116.2 represents Math 116E students. There was a significant difference between ACT and MPE scores favoring the regular college algebra course, so a t-test was conducted to test the significance of the difference in the mean of the points achieved in Math 116 and Math 116E. The results appear in Table 3.

TABLE 3

THE REULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN POINT ACHIEVEMENT IN MATH 116 VERSUS MATH 116E



t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	1.5699	0.193	73	0.8477
Std Error	8.2461			
Lower 95%	-14.8455			
Upper 95%	18.0233			

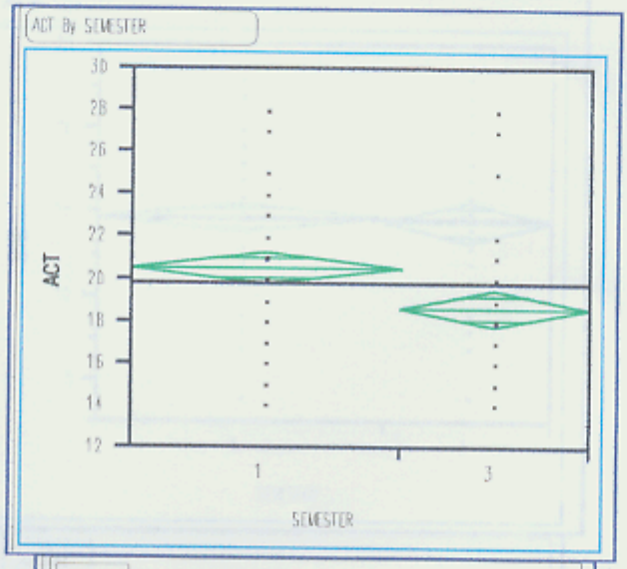
Assuming equal variances

There was no significant difference in the achievement of Math 116 students and Math 116E students even though Math 116E had significantly lower ACT and MPE scores. To compare the overall success of college algebra students this semester with college algebra students last semester before the extended class, a t-test was conducted to determine if a difference in the mean of the ACT scores and MPE scores existed. The results are given in Table 4 and Table 5.

TABLE 4

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN ACT SCORES OF PREVIOUS SEMESTER 116 STUDENTS TO CURRENT SEMESTER STUDENTS WITH EXTENDED CONDITION

The number <u>one</u> represents the current semester, and the number <u>three</u> is the previous semester.



t-Test

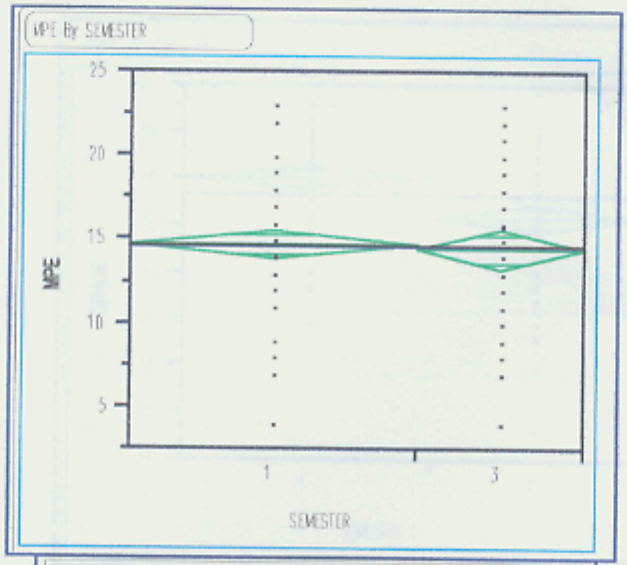
	Difference	t-Test	DF	Prob>|t|
Estimate	1.92754	3.152	115	0.0021
Std Error	0.61150			
Lower 95%	0.71626			
Upper 95%	3.13881			

Assuming equal variances

TABLE 5

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN MPE SCORES OF PREVIOUS SEMESTER 116 STUDENTS TO CURRENT SEMESTER STUDENTS WITH EXTENDED CONDITION

The number one represents the current semester, and the number three is the previous semester.



t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	0.24864	0.320	107	0.7494
Std Error	0.77838			
Lower 95%	-1.29540			
Upper 95%	1.79467			

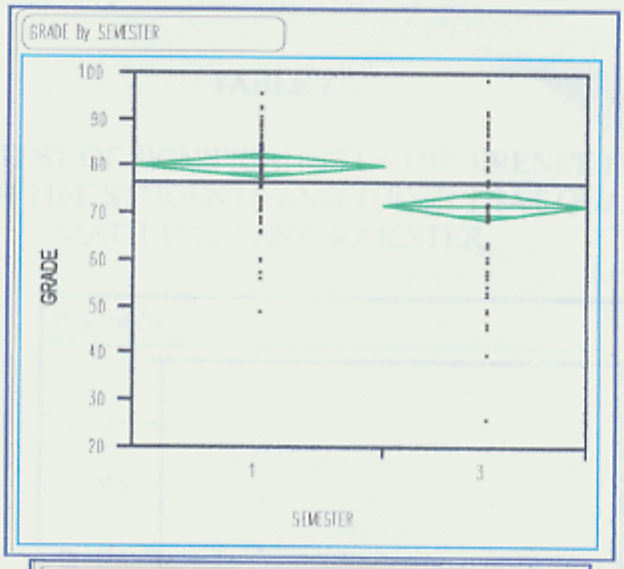
Assuming equal variances

The number one represents the current semester's algebra students while the number three represents the previous semester's algebra students. Although this semester's students scored significantly better on the ACT, there was no significant difference in MPE scores. Therefore, a t-test was conducted to see if a significant difference existed between percentage grades achieved by college algebra students last semester versus this semester. The results are in Table 6.

TABLE 6

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN PERCENTAGE GRADES OF PREVIOUS AND CURRENT COLLEGE ALGEBRA STUDENTS

The number one represents the current semester, and the number three is the previous semester.



t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	8.4169	3.853	133	0.0002
Std Error	2.1844			
Lower 95%	4.0963			
Upper 95%	12.7376			

Assuming equal variances

There was a significant difference in achievement between college algebra students this semester and those last semester. Overall, achievement for college algebra students this semester was significantly higher than student achievement last semester.

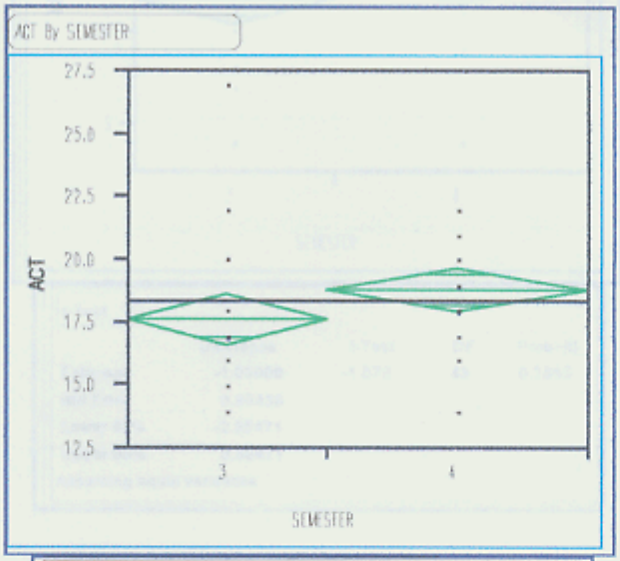
Because no significant difference in ACT and MPE scores between Math 116E students this semester and those that met the requirements for Math 116E last semester

occurred (Tables 7 and 8), a t-test was conducted to observe if a significant difference existed between their achievements in college algebra. The results are contained in Table 9.

TABLE 7

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN ACT SCORES OF MATH 116E STUDENTS AND THOSE THAT QUALIFIED FOR MATH 116E LAST SEMESTER

The number three represents the previous semester, while the number four represents the current semester 116 students.



t-Test

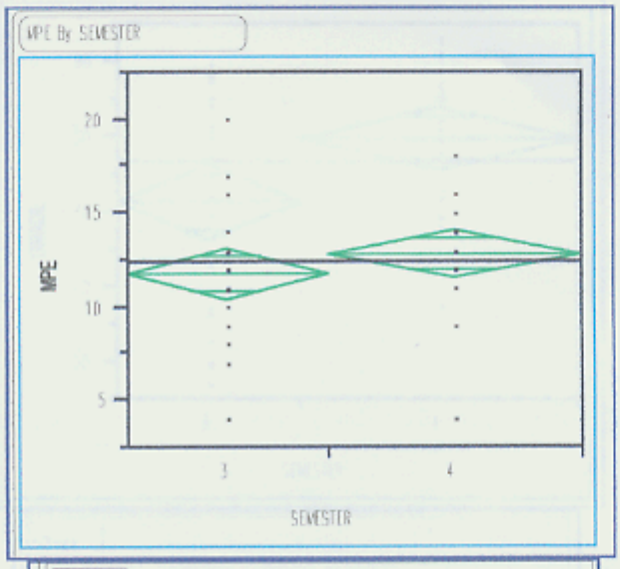
	Difference	t-Test	DF	Prob>|t|
Estimate	-1.23462	-1.737	44	0.0893
Std Error	0.71065			
Lower 95%	-2.66686			
Upper 95%	0.19763			

Assuming equal variances

TABLE 8

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN MPE SCORES OF MATH 116E STUDENTS AND THOSE THAT QUALIFIED FOR MATH 116E LAST SEMESTER

The number three represents the previous semester, while the number four represents the current semester 116 students.



t-Test

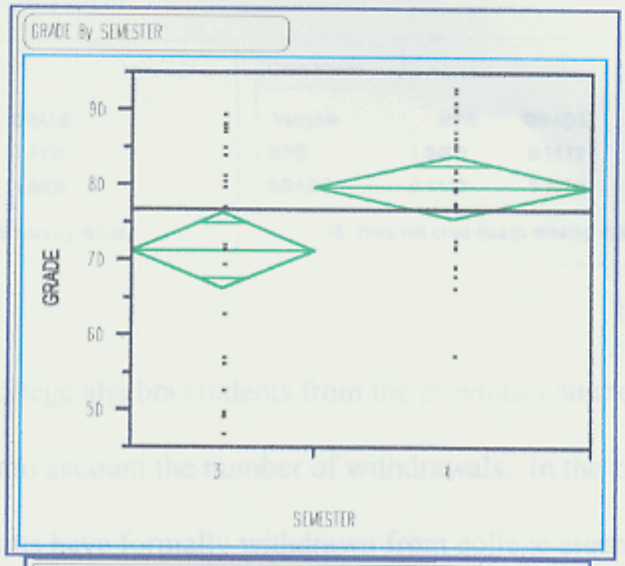
	Difference	t-Test	DF	Prob>|t|
Estimate	-1.03000	-1.079	43	0.2865
Std Error	0.95439			
Lower 95%	-2.95471			
Upper 95%	0.88471			

Assuming equal variances

TABLE 9

THE RESULTS OF TEST OF SIGNIFICANCE OF DIFFERENCE IN MEAN ACHIEVEMENT SCORES OF MATH 116E STUDENTS AND THOSE THAT QUALIFIED FOR MATH 116E LAST SEMESTER

The number three represents the previous semester, while the number four represents the current semester 116 students.



t-Test

	Difference	t-Test	DF	Prob>|t|
Estimate	-8.4314	-2.515	48	0.0153
Std Error	3.3520			
Lower 95%	-15.1711			
Upper 95%	-1.6918			

Assuming equal variances

Three represents data from the previous semester while four represents data from the current semester. It is evident that the current semester's Math 116E students scored significantly higher in college algebra than students who qualified for Math 116E last semester but were enrolled in regular Math 116.

The correlations between ACT scores and MPE scores and achievement are given in the following tables. There is a positive relationship between MPE scores and achievement, but the relationship between ACT and achievement is even stronger.

Correlations

Variable	ACT	GRADE
ACT	1.0000	0.4155
GRADE	0.4155	1.0000

18 rows not used due to missing values.

Correlations

Variable	MPE	GRADE
MPE	1.0000	0.1112
GRADE	0.1112	1.0000

26 rows not used due to missing values.

In analyzing the college algebra students from the previous and the current semester, one must take into account the number of withdrawals. In the current semester, only three students have formally withdrawn from college algebra, and two of these were for non-academic reasons. One student simply stopped coming and did not properly withdraw, so he received an "F." In the previous semester, there were eight withdrawals and three additional students who had stopped attending at the same point in the semester and received a grade of "F."

The questionnaire presented very positive feedback about the extended version of college algebra. Even though a survey presents no scientific evidence and is merely opinion, it is still essential to see if the students themselves believe Math 116E is beneficial. All of the students, with the exception of one who was undecided, believed that Math 116E contributed to their success in college algebra. Approximately two-thirds of the class continuously kept up with the homework and reviewed notes nightly.

On supervised study days, the majority of the students preferred a combination of both working in groups and working alone, depending on the nature of the assignment. When asked if they would recommend Math 116E to a friend, the unanimous response was "yes."

FINDINGS

Math 116E students were able to attain achievement scores that were very similar to the achievement scores of the regular Math 116 class, even though their ACT and MPE scores were significantly lower. This is of even greater importance because the instructor commented that in her opinion the regular college algebra class this semester achieved well above most Math 116 classes she had had in the past. It is very significant that the Math 116E class was able to keep up. Overall, college algebra students this semester (Math 116 and 116E) had higher achievement levels than did college algebra students last semester under the same instructor. There was no significant difference in Math Placement Exam scores between the two semesters. Comparing students from last semester that would have qualified for Math 116E and current Math 116E students, there was no significant difference in ACT and MPE scores. However, there was a significant difference in achievement. Math 116E students this semester scored significantly higher in college algebra than those who met the requirements for the extended version last semester.

After the addition of Math 116E, there were fewer withdrawals and failures from the lack of attendance as compared to last semester. Thirteen of the thirty students

enrolled in Math 116E this semester were transferred from Math 100 courses. Thus, Math 116E saved these students a semester in mathematics because Math 100 does not count toward any major. Student response indicated that all of the students, except one who was undecided, believed Math 116E contributed to their success in college algebra. All of the students indicated that they would recommend the extended version of college algebra to a friend if given the opportunity.

LIMITATIONS

There were several limitations of this study. First, the major threat to validity is the inability to know how much mathematical experience each individual student had prior to enrolling in college algebra. Some students may have studied the material in previous classes, while this could have been the first time other students were exposed to the information. Secondly, there is no way to determine how much time each student spent outside of class preparing for class and studying. Students were still expected to attempt the daily homework assignments outside of class so that time in class could be used most effectively. Some students did all of the assignments outside the class while others waited until they arrived to begin. This would be another factor in their achievement levels.

Furthermore, the regular MATH 116 class met in the morning, while MATH 116E met in the afternoon. By the afternoon, many students are anxious to be done with school for the day, possibly affecting their concentration and performance in the classroom. Another threat to the validity of this study was the fact that the current year's algebra students may not be typical of the students in the past or the students in the future. The instructor plainly stated that the regular MATH 116 students for the 1997 fall semester were above average. In addition, this project only sampled a small number of

algebra students as compared to overall student enrollment in algebra classes at Western Kentucky University. This study was conducted under students having the same instructor. Different teaching strategies and instruction methods could also influence student achievement. The data used for analysis in this research was collected over a limited time frame, which again could affect results.

CONCLUSIONS AND RECOMMENDATIONS

The overall goal of educators is to provide effective instruction to aid students in their educational endeavors. In accordance, one goal of the Western Kentucky University Mathematics Department is to increase the success rate of college algebra students. The extended version of Math 116 seems to have been a success. It increased achievement in students who originally were enrolled in a lower-level mathematics refresher course and boosted overall achievement for lower-level students to the level of the regular college algebra course. Statistics support that college algebra students this semester attained a higher achievement level than those in the past.

Recommendations were made concerning the implementation of future extended college algebra courses and needed research on the basis of the findings and conclusions of this study. Based on the evidence, one recommendation is that in the future the Department of Mathematics should offer extended college algebra courses in order to increase student achievement. This study should also be extended until the end of the semester to see if the same results hold. Different teaching styles would have an impact on the outcome; thus, another recommendation is to look at results for classes taught by other instructors. Studies should also be conducted to measure the most effective classroom behavior during supervised days such as working in groups, short lectures, and homework procedures.

APPENDIX

MATH 116E QUESTIONNAIRE

1) **Has the extended version of Math 116 contributed to your success in college algebra? Why or why not?**

YES---26 Students (97%)
UNDECIDED---1 Student (3%)
Comments---provided time to keep up with homework, extra help if necessary, one-on-one help, material stays fresh on my mind, seems like slower pace

2) **How much of your homework did you complete outside of class the majority of the time? Circle one.**

All	Some	None
(33%)	(63%)	(4%)

3) **Do you each night review your notes, try to do the homework, and formulate any questions you have before coming to class the next day? Circle one.**

Always	Sometimes	Never
(15%)	(78%)	(7%)

4) **On non-lecture days, do you prefer to work in groups, work alone, or a combination of both?**

Work in Groups (15%) Work Alone (4%) Combination (81%)

5) **Given the opportunity, would you recommend to a friend to enroll in Math 116E? Circle one.**

Yes	No
(100%)	(0%)

6) **Other comments**
More confident because can get extra help, teacher has a great deal to do with success of class, work days are great, Math 116E should be offered in the future

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