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ABSTRACT
              In fall 1991, a study was initiated at Central
Florida Community College (CFCC) in Ocala to examine the effects of
computer lab tutorials and cooperative learning on mathematics
achievement, retention rate, mathematics anxiety, mathematical
confidence, and success in future mathematics courses among 29
students in an intermediate algebra class. Another course section of
23 intermediate algebra students, taught by the same instructor but
utilizing the traditional lecture method, served as a control group.
The experimental section was divided into groups of two to four
students having similar achievement placement test scores. Homework
assignments, computer lab tutorials, and all tests (except for the
final exam) were completed on a group basis, with issues of
assignment and lab meeting times, group participation guidelines, and
class attendance decided and monitored by the group. Both classes
were given the Fennema-Sherman Mathematics Anxiety and Confidence
Scales test before and after the course. Study findings included the
following: (1) a total of 23 students in the experimental group, and
15 students in the control group completed the course; (2) the
control group showed greater increases in post-course confidence
ratings and greater reductions in anxiety ratings than the
experimental group; (3) 69% of experimental group students received a
course grade of A, B, or C, as compared with 52% of the control
group; and (4) 87.5% of control group students were successful in
their subsequent math course compared to 80% of the experimental
group students. Data tables, and narrative excerpts of midterm and
final written evaluations by students in the experimental group are
included. (PAA)

# The Application of Computer Technology and Cooperative Learning in Developmental Algebra at the Community College

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# Cooperative Learning Model

This study was undertaken to determine if a model for the integration of computer technology and cooperative learning was appropriate for students in intermediate algebra. The areas of concern to be addressed were mathematics achievement, retention rate, mathematics anxiety, mathematical confidence, and success in future mathematics courses.

This study was begun in the Fall semester of 1991 with two intermediate algebra classes at Central Florida Community College. Prior to the beginning of the semester one class was randomly selected as the control group and the other as the experimental group. The control group was instructed by the traditional lecture method. The experimental group was instructed by a combination of lecture and cooperative group work in class and in the computer laboratory. The control group was also given the opportunity to use the computer laboratory as an outside resource. Both groups were taught by the same instructor.

The experimental group was divided into small groups of two to four students based on the placement test score. Students demonstrating similar achievement were grouped together. The students were given the option to participate in the group process. Any student could withdraw from the group process at any time--become a group of one. All students chose to remain in their group. The class was initiated in the group process by the instructor. They were given definite rules and responsibilities that had to be observed for

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continued participation in the group process. Each person in the group was responsible for equal participation. That is, each person had to "carry their share of the load." The members of the group were responsible for "policing" themselves. If an individual member were not effectively participating or taking advantage of the group, the other members of the group could confidentially report this problem to the instructor for solution. Group members took their roles seriously; only one group disintegrated. However, throughout the course of the semester, some students were lost to either withdrawal from the course or withdrawal from school.

The responsibilities of the group were homework assignments, computer laboratory assignments, tests, and attendance of all members of the group. The homework assignments were to be completed as a group. The arrangement of this procedure was the decision of the group. Some groups met in various locations on campus; others conferred via the telephone. Also, they were given approximately 15 minutes of class time to confer on homework.

Approximately once a week, the groups were given computer laboratory assignments. The students were to arrange to meet in the computer laboratory to complete assigned tutorials. The software utilized for these assignments were a tutorial that accompanied the textbook and two problem solving packages. No grade was attached to this requirement. The students self-reported completion of these assignments.

On test days, the students divided into their groups to complete the test.

The groups had the responsibility to decide how to approach the group testing process. The group dynamics were interesting to observe. Some groups chose to complete individual tests, then compare and reach consensus; others worked each problem and reached consensus as they went. The group then turned in a group test paper. A single grade was assigned to the paper with each member of the group receiving the same grade.

For class attendance, groups were responsible for individual members. If a member were going to be absent, that person was responsible for reporting the intended absence to the group before class. Further, the group was responsible for explaining class material to the absent member.

All assignments and tests were the same for both the experimental group and the control group. The only individual achievement measure for the experimental group was the common departmental final that was required of all students enrolled in intermediate algebra. The final examination only accounted for 10% of the final course grade.

At midterm and at the end of the semester, the experimental class was asked to give a written evaluation of the group process. It was emphasized that they should be completely candid in these evaluations as they had absolutely no influence on course grades. Portions of these narratives are included as qualitative results.

## Midterm Evaluation Comments

"It was a new experience for me to be in a classroom after being out of school for three years. When I went into each new class and didn't know anybody, I was kind of nervous. I would wonder how I could make new friends and meet people. The study groups gave me an opportunity to do that and be more relaxed about being in class."

"Everyone in our group puts a lot of effort into their work."

"It is good to have two other people help me one on one. This situation will help me work harder in order to contribute to the group."

"I remember more by talking the problems over with the other people in my group. I feel real comfortable in my group."

"If I encounter problems usually there is someone in the group that can help. Sometimes it is easier to learn from a student than from the teacher."

"I seem to understand it better and if I have any questions I just ask my group. Everyone in my group is helpful to one another."

"...we can all help each other out until everyone understands...we work well together."

"It's a learning experience where you can learn from others and they learn from you...it's frustrating when certain members don't put forth as much effort as others, but I'll just do my best to try and help them."

"When I do my homework and test and compare with my group...I'm able to correct it with understanding."

"Normally I would not ask people to study with me, but with the groups it makes it more comfortable to get together. I feel that the group is an effective learning tool."

"I really do think the group helps me learn better because we get together and help each other. I don't think these groups would work if the members didn't try and just relied on the others for answers."

"I have never felt comfortable in math. For the first time since I can remember, I am not in sheer terror at the thought of a test. For the first time I am learning while I am testing. It has given me greater confidence in math."

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"This is more similar to a real world work situation."

"... if someone in the group understands something then they teach the rest of the group."

"... working together with others has tended to build my confidence a little."

## Final Evaluation Comments

"The groups were a very helpful learning tool. I learned a lot from my fellow students. I know that the group enabled me to perform better than I would have without the group."

"It not only taught us math, but also how to communicate and work with others. My group and I had study sessions the night before a test. Without a group I never would have studied. It also helped me build two more friendships."

"I feel that I learned as much if not more with the group. One girl did not even try in our group but she dropped the class anyway."

"I believe the group process is very beneficial to learning because you have more than one person to confer with and help you understand. I have never enjoyed a math class more. It was really a fun and different way to learn."

" I think the group idea was a very good one, but I found as soon as we started the group I started to fall behind in my homework. But I did learn more algebra in this class than in any other."

" It was much better for a student like myself who needs a little inspiration to help him or her study."

" I feel I learned more because what I didn't learn in class I learned from my partners. Mark and I have College Algebra together next semester and we are going to carry on with our group study because we work well together."

" I've taken this class three times and this is the first time I've felt comfortable. If I didn't understand something I could always go to my group. The method works great--at least it did for me."

" I did not feel nervous at all when we had a test. The idea of a test always put a little stress on me."

"I really think I learned more being in a group with my peers."

"I feel I was well prepared for the final and the group structure helped me to be prepared."

"I've taken this class before and I feel that I have learned more this term."

"I believe the groups have been a motivator...if you want to learn you will use every tool available."

Table 1. Fennema-Sherman Mathematics Anxiety Scale Results

|  | Experimental Group | | Control Group | |
|---|---|---|---|---|
|  | initial | final | initial | final |
| Anxious 1.00 - 2.49 | N = 9 (31%) | N = 6 (26%) | N = 5 (21.7%) | N = 2 (13%) |
| Ambivalent 2.50 - 3.49 | N = 10 (34.5%) | N = 9 (39%) | N = 10 (43.5%) | N = 3 (20%) |
| Non-Anxious 3.50 - 5.00 | N = 10 (34.5%) | N = 8 (35%) | N = 8 (34.8%) | N = 10 (67%) |

Table 2. Fennema-Sherman Mathematics Confidence Scale Results

|  | Experimental Group | | Control Group | |
|---|---|---|---|---|
|  | initial | final | initial | final |
| Non-Confident 1.00 - 2.49 | N = 4 (14%) | N = 3 (13%) | N = 4 (17%) | N = 2 (13%) |
| Ambivalent 2.50 - 3.49 | N = 10 (34.5%) | N = 8 (35%) | N = 8 (35%) | N = 2 (13%) |
| Confident 3.50 - 5.00 | N = 15 (52%) | N = 12 (52%) | N = 11 (48%) | N = 11 (74%) |

Table 3.    Group Means for Initial and Final Administrations of the Fennema-Sherman Anxiety and Confidence Scales

| | Anxiety Scale | | Confidence Scale | |
|---|---|---|---|---|
| | initial | final | initial | final |
| Experimental Group | 3.18 (N = 29) | 3.19 (N = 23) | 3.41 (N = 29) | 3.36 (N = 23) |
| Control Group | 3.13 (N = 23) | 3.60 (N = 15) | 3.41 (N = 23) | 3.82 (N = 15) |

Table 4.  Distribution of Final Course Grades

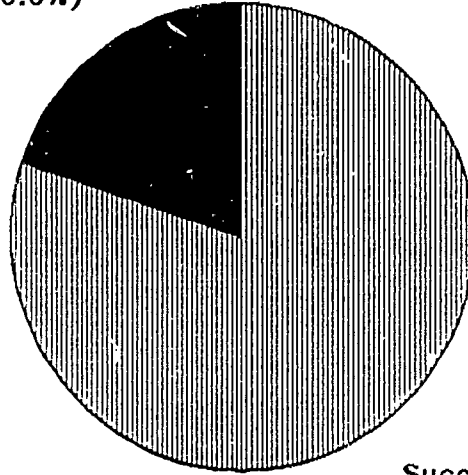| | Experimental Group | Control Group |
|---|---|---|
| A | 7 | 5 |
| B | 8 | 3 |
| C | 5 | 4 |
| | (69%) | (52%) |
| D | 3 | 3 |
| F | 2 | 0 |
| W | 4 | 8 |
| | (31%) | (48%) |
| | N = 29 | N = 23 |

Table 5.    Results of  Successful Students in the Following Semester
            Mathematics Course

|                | Experimental Group | Control Group |
| -------------- | ------------------ | ------------- |
| Success        | 8                  | 7             |
| Non-Success    | 2                  | 1             |
| No Math        | 8                  | 5             |
| Not in School  | 2                  | 2             |
|                | N = 20             | N = 15        |

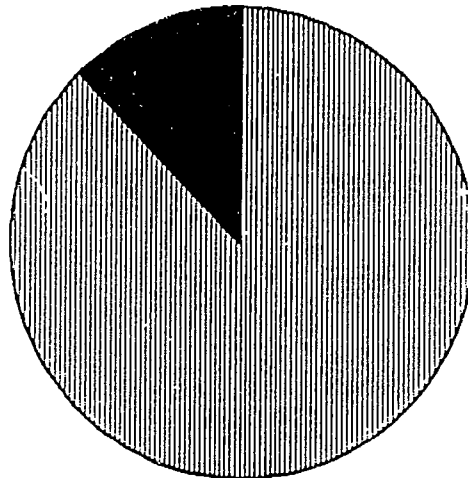Experimental Group
Success/non-success in next course

Non-Success (20.0%)



Success (80.0%)

Control Group
Success/non-success in next course

Non-Success (12.5%)



Success (87.5%)

# Fennema-Sherman Mathematics Anxiety and Confidence Scales

To assess mathematics anxiety and mathematics confidence of the groups, both groups were administered the Fennema-Sherman Mathematics Anxiety and Mathematics Confidence Scales at the beginning and end of the semester (Fennema & Sherman, 1976). Items 1 - 12 are a measure of mathematics anxiety described as "... intending to measure feelings of anxiety, dread, nervousness, and associated bodily symptoms relating to doing mathematics. The dimension ranges from feelings of ease, to those of distinct anxiety" (Fennema & Sherman, 1976, p.4). Items 13 - 24 are a measure of mathematical confidence that is "... intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimension ranges from distinct lack of confidence to definite confidence" (Fennema & Sherman, 1976, p.4). The scales are measured on a five-point Likert scale, with responses from (1) strongly disagree to (5) strongly agree. Each scale has the first six items positively worded and the last six items negatively worded. Thus, the negatively worded items are reversed in scoring. The scores of the Fennema-Sherman Scales are interpreted according to the following:

| Score | Confidence Scale | Anxiety Scale |
|---|---|---|
| 1.00 - 2.49 | non-confident | anxious |
| 2.50 - 3.49 | ambivalent | ambivalent |
| 3.50 - 5.00 | confident | non-anxious |