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ABSTRACT

In recent years, many schools have turned to Integrated Learning Systems (ILSs) to facilitate instruction and assist with raising state standardized test scores. Typically, these ILSs are utilized in a computer lab with students working individually on computer-based instructional lessons for an allotted time period. Using ILSs in this manner has created problems such as increasing anxiety, hostility, and boredom in students. Through the integration of cooperative learning with ILS delivery, some of these problems could be alleviated. This study examined achievement and behavior differences between elementary school students completing ILS activities in a traditional, individualized format, and students completing the same activities in cooperative learning groups. This was in order to determine if a cooperative learning model could be used effectively with students completing mathematics activities in a lab-based ILS. In addition, this study aimed to discern if the cooperative strategy was more effective for students with high or low academic ability levels. Achievement and attitudinal data were collected for all fifth grade students in the selected school prior to the experiment and at the end of the treatment period. Results revealed that students using an ILS for mathematics instruction performed better on standardized tests and that attitudes were more positive when they completed the computer activities in cooperative groups. (Contains 38 references.) (Author/AEF)

Title:

The Effectiveness of Cooperative Learning for Low- and High-Achieving Students Using an Integrated Learning System

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Abstract

The purpose of this study was to determine whether integrating cooperative learning strategies with ILS-delivered instruction in mathematics produced academic and attitudinal gains in students and, if so, to discern if this strategy was more effective for students with high or low academic ability levels. In order to gauge the efficacy of the intervention, achievement and attitudinal data were collected for all fifth grade students in the selected school prior to the experimental treatment and at the end of the treatment period. Results of this study revealed that students using an ILS for mathematics instruction performed better on standardized tests when they completed the computer activities in cooperative groups. In addition, attitudes and behaviors were more positive towards math and the computer math activities when the students worked in cooperative groups.

In recent years, many schools have turned to Integrated Learning Systems (ILSs) to facilitate instruction and assist with raising state standardized test scores (Becker, 1994). Typically, these ILSs are utilized in a computer lab, where teachers brings their classes into the lab and students work individually on computer-based instructional lessons for an allotted time period. In this model of ILS delivery, students are generally isolated from one another, and are discouraged from sharing information or providing assistance to other students. Although using ILSs in this manner may fit well with the *initial* design and purpose of ILSs (i.e. instruction tailored to individual needs), it has also created problems such as increasing anxiety, hostility, and boredom in students (Lepper, 1985).

Through the integration of cooperative learning with ILS delivery, some of these problems may be alleviated. This study examined achievement and behavior differences between students completing ILS activities in a traditional, individualized format, and students completing the same activities in cooperative learning groups in order to determine if a cooperative learning model could be used effectively with students completing mathematics activities in a lab-based ILS.

THEORETICAL BACKGROUND

Cooperative Learning

Cooperative learning as an instructional strategy for students of varying achievement levels has been widely researched over the past twenty years. In a typical cooperative learning situation, students are grouped together in some manner and asked to work together to complete a task, such as to master some instructional material, develop a report on certain subject matter, or complete a creative project (Lloyd, Crowley, Kohler, & Strain, 1988). Rewards for the individual students within the group are generally based on the accomplishments of the group as a whole. Proponents of cooperative learning argue that having groups of students work together towards a common goal with shared rewards will lead to both academic and social gains for all students participating in the lessons (Johnson & Johnson, 1982; Mesch, Lew, Johnson, & Johnson, 1986).

Researchers have proposed a variety of cooperative learning models in various instructional setting. However, Slavin (1985) has noted that while different cooperative learning models may vary in implementation, they are generally utilizing alternative methods for ensuring that the key elements of cooperative learning are integrated into the instructional task. These key elements of cooperative learning, as outlined by leaders in cooperative learning research such as Johnson and Johnson (1987), and Slavin (1990, 1980), include:

(1) Positive interdependence. Students must believe that each one of them has a key role in the group, and that the task to be accomplished cannot be completed without the actions of each member.

(2) Individual accountability. Each student within a group must be held accountable for mastery of the instruction presented to the group.

(3) Group rewards. There must be sufficient incentives for the group to remain together. The accomplishments of the group as a whole should be rewarded just as the accomplishments of each individual are rewarded.

(4) Group training. Students cannot be placed together in a group situation and be expected to cooperate. As Johnson and Johnson (1987) state, "students must be taught the social skills needed for collaboration, and they must be motivated to use them" (p. 13).

Cooperative Learning's Effects on Achievement

Research examining the academic impact of cooperative learning has provided mostly positive results. Slavin (1983) examined 46 studies in which cooperative learning groups were compared with individual instruction. Of those 46 studies, he found that 29 reported a significant increase in achievement levels for students participating in cooperative learning groups, with another 15 showing no significant differences. Slavin further noted that the studies which did not show learning gains for students in cooperative learning groups did not incorporate one or more of the important components of cooperative learning outlined above. In a second meta-analysis, Slavin (1987) analyzed studies which compared the effects of cooperative learning on achievement with those of students in individual learning situations. Of the 38 studies reviewed, Slavin found that 33 reported significant increases in academic achievement for students participating in cooperative learning situations.

Research has also examined the effectiveness of cooperative learning with students of different academic ability levels. Many proponents of cooperative learning believe that, when implemented properly, cooperative learning is effective for students of all academic ability levels. However, some researchers argue that cooperative learning is not as effective with students of low-ability levels. For example, in a qualitative study by King (1993), third-grade students received mathematics instruction in cooperative groups consisting of two students classified as being high-achieving and two students classified as being low-achieving. Observations of the students working in the cooperative groups revealed that students classified as low-achieving tended to make minimal contributions to the group work and took on passive roles within the group, whereas the students classified as high achieving completed the majority of the group work without input from the other members of the group. This research also noted that "...low achievers were not learning to any significant degree. Lows' self-perceived lack of progress in small groups may indicate that their developing of mathematical understanding and skills is not enhanced by small-group work." (King, 1993, p. 413).

Other research, however, has shown that low-ability students benefit from cooperative learning strategies. In a study by Simsek and Hooper (1992), 30 fifth and sixth grade students worked either independently or cooperatively on a videodisc lesson about whales. The cooperative groups were composed of either one student classified as "low ability" and two students classified as "high ability," or two students classified as "low ability" and one student classified as "high ability." Posttest results revealed that students participating in cooperative groups, regardless of ability level, scored significantly higher. Similar positive effects of cooperative learning with students of varying ability levels were discussed by Hooper (1992), Watson and Rangel (1989), Slavin (1991), and Johnson and Johnson (1992).

Cooperative Learning's Effects on Student Attitudes and Social Behaviors

Research shows that cooperative learning can have a positive impact on students' social behaviors and attitudes towards instructional content. In a study by Farivar (1992), seventh-grade students worked on mathematics assignments in cooperative groups. Results of the study indicated improved attitudes towards both cooperative learning activities and mathematics in general. Good, Reys, Grouws, and Mulryan (1989-1990) found that cooperative group work in mathematics increased students' motivation and enthusiasm towards the subject matter. Similar findings were reported by Davidson and Kroll (1991) and Slavin (1985).

In terms of effects on social behaviors, Mesch, Lew, Johnson, and Johnson (1986) placed students in cooperative learning situations and provided them with training on effectively interacting in those situations. As a result of the training and cooperative group experiences, these researchers found that students who tended to be isolated and withdrawn interacted significantly more with their peers both within and outside the cooperative learning activities. In a meta-analysis of five studies dealing with cooperative learning, Lloyd, Crowley, Kohler, and Strain (1988) concluded that cooperative learning had significant positive effects, "particularly on social behavior, in comparison to competitive and individualistic procedures." (p. 43). Several studies have found that cooperative learning improves relationships between disabled and non-disabled peers (Armstrong, Johnson, & Balow, 1981; Madden & Slavin, 1983; Yager, Johnson, Johnson, & Snider, 1985), and between students from different ethnic and racial backgrounds (Slavin, 1983). Research has also shown cooperative learning to decrease behavior difficulties such as talking out and not paying attention in the classroom (Greenwood, Carta, & Hall, 1988; Mulryan, 1995; Tyrrell, 1990).

Integrating Cooperative Learning with Computer-Assisted-Instruction and ILSs

As interest in applying cooperative learning in a wider variety of instructional settings has grown, there has been an increase in research investigating integration of cooperative learning with other instructional tools. One such combination is cooperative learning and computer-assisted-instruction (CAI). Some have argued that, by providing students with peer support and assistance when utilizing traditionally individualized tools such as CAI, cooperative learning can increase the effectiveness those tools have on student achievement (Becker, 1992). For example, Mevarech, Stern, and Levita (1987) placed junior high school students into cooperative learning groups and asked the groups to complete language arts CAI lessons. Results indicated that students who worked on the CAI lessons in cooperative groups demonstrated significantly greater academic gains than their peers working on the CAI lessons individually. Similar positive results when combining cooperative learning and CAI were found by Hooper and Hannafin (1991), and

Hooper, Temiyakarn, and Williams (1993). In these studies, peer interactions, positive student attitudes towards the group activities, and the construction of a supportive learning environment were all determined to be factors which contributed to positive academic gains for students.

In the past few years, CAI has evolved into powerful and costly systems, such as ILSs (Wiburg, 1995). An ILS is generally implemented in a computer lab of 15 to 30 computers linked to a central fileserver. The fileserver contains instructional software which contains entire curricula in reading, writing, mathematics, science, or other disciplines, over several grade levels (Bender, 1991; Robinson, 1991). This software is individually distributed to each computer in the computer lab, so that each student using the lab can work on any lesson at any given time. With this system, teachers (or students) can simply select the lessons they wish to use by choosing from a menu, or they can allow the computer to determine the appropriate content and difficulty level for particular students. In the latter case, the ILS selects and assigns lessons which either introduce new concepts or provide remediation of more difficult concepts according to the needs of each student. The ILS can also maintain detailed records of each student's progress and performance which the teacher can access at any time for assessment and evaluation purposes.

The research dealing with the academic effectiveness of combining cooperative learning with ILS-delivered instruction is somewhat limited. Mevarech (1994) investigated the impact of using a cooperative versus individual model when using an ILS system developed in Israel. Results of this study indicated that students working in cooperative groups performed significantly better on tests of both mathematics basic skills and higher-level concepts than their peers working individually.

Knowledge about the effectiveness of integrating ILSs and cooperative learning could prove invaluable to teachers and administrators who are struggling to incorporate ILS instruction into their curriculum. The large cost of establishing and maintaining such systems, coupled with limited resources, force many school districts to target specific students to use ILS resources (Becker, 1994). This becomes necessary when schools do not have the facilities to serve all students. If cooperative learning in an ILS setting were shown to be effective, not only will students benefit from an academic and social learning perspective, but school districts will be able to utilize their ILS resources more efficiently by serving more students.

The purpose of this study was to determine whether integrating cooperative learning strategies with ILS-delivered instruction produced positive academic and attitudinal gains in students. In addition, this study examined the effectiveness of combining ILS and cooperative learning with students of different academic ability levels. Student achievement test data, results from an attitudinal questionnaire, and researcher observations of student behavior were used to determine significant differences between the treatment groups.

METHOD

Subjects and Setting

The subjects were 65 fifth grade students in one selected elementary school located in a small city in the upper midwest. The school selected for the study was the second-largest of the three elementary schools in the school district, with an overall enrollment of approximately 520 students. The teacher/ student ratio for the selected school was approximately 1:20, with an average class size of 25 students.

The children enrolled in the school were generally from households with low to lower-middle socioeconomic status, and the average income of families served by the school was approximately $12,000. As a result of the low socioeconomic levels in the community, approximately 43% of the students served by this school were eligible for free or reduced lunches under federal guidelines. The school also served children whose parents were military personnel, which accounted for approximately 20% of the total student population. The ethnic distribution of the students was approximately 60% Caucasian, 30% African-American, and 10% from other ethnic groups.

Initially, 71 students were eligible to participate in the study by virtue of their enrollment in one of the three fifth-grade classrooms at the school. However, two students left the district during the second week of school, two students left school immediately after completing the pre-tests, and parental consent was not received from two other students. One new student enrolled in the school during the fifth week of the study, but was not included in data collection. Thus, a total of 65 students participated in the study. The ethnic breakdown of the students participating was 70% Caucasian, 25% African-American, and 5% Asian-American. Thirty-seven percent of the students were female, and 63% were male.

Students participating in this study had already used the ILS labs and the computerized mathematics curriculum for a year, so training on use of the computer was not necessary. Any students new to the district received an orientation to the ILS lab as mandated by school computer-use policies.

Design and Materials

This study used a 2 X 2 (treatment group X ability level) posttest-only design to determine achievement differences. All subjects were blocked by ability based on pretest scores. The dependent variable was mathematics achievement. This variable was operationally defined as the achievement test post-test scores.

Since intact classes were used in assigning students to treatments, the difference in group pretest scores could not be fully accounted for experimentally. The pretest mean of students in the control group ($\underline{M}$ = 45.95) was somewhat higher than the mean of the students in the experimental group ($\underline{M}$ = 45.07). This difference in pretest means was not significant, $F(1,64) = 0.88$, $\underline{p} = .352$, however, owing to the importance of student ability in the present study posttest data were analyzed using an analysis of covariance (ANCOVA) with student pretest scores as the covariate. The ANCOVA procedure is recommended by Taylor and Innocenti (1993) to increase statistical power.

To determine attitudinal differences between the treatment groups, separate chi-squares were calculated using the student responses obtained for each of the attitudinal questions on the student exit questionnaire.

Testing Instrument - The California Achievement Test, Fifth Edition (CAT/5), was used as both the pre- and post-test instrument for mathematics achievement. For this study, students completed parallel forms of Level 15 of the entire mathematics battery (Form A for the pre-test and Form B for the post-test). Level 15 is the grade 5 level of the test (grade range 4.6 - 6.2). Both versions of the test consisted of 94 questions, 44 of which pertained to math computation and 50 to math concepts and applications. The mathematics computation portion of the test covered traditional computation operations such as whole numbers, decimals, fractions, integers, percents, algebraic expressions, estimation and using hand-held calculators. The mathematics concepts and applications portion focused on problem solving, which includes the "...broad range of strategies and critical-thinking skills students use in confronting problems based in any area of mathematics." (CTB/Macmillan/McGraw-Hill, 1992, p.9).

Level 15 of the mathematics section of the test has a standardized mean of 58.38, a standard deviation of 18.00, and a standard error of measurement of 4.01. Split-half reliability of the test, as measured by the Kuder-Richardson Formula 20 measure of internal consistency was 0.95 (CTB/Macmillan/McGraw-Hill, 1992).

Curriculum - The Jostens mathematics curriculum was used as the instructional content. This curriculum covered the entire range of the 5th grade curricular objectives for mathematics for the state of Michigan, as outlined by the Michigan Essential Goals and Objectives for Mathematics (Jostens Learning Corporation, 1990). The mathematical concepts covered in these objectives for grade five include whole numbers and numeration; fractions, decimals, ratios, and percents; measurement; geometry; statistics and probability; algebraic ideas; problem solving and logical reasoning; and calculators. These concepts also corresponded to the objectives covered on the California Achievement Test (Jostens Learning Corporation, 1993).

Delivery - The instruction was delivered via a networked ILS lab, with 30 computer stations in the lab. With this delivery method, each student (or pair of students) received mathematics lessons as determined by their performance and progress.

Training Documents - Training materials and activities were developed to assist students with establishing their cooperative groups, and to help students understand their roles and responsibilities as members of groups. There were two separate cooperative activities used to provide training in cooperative learning strategies, one domain-general and the other domain-specific. The domain-general activity provided students with an opportunity to work together to complete a task that was not related to any particular content area. The second activity specifically dealt with mathematics concepts.

Student Exit Questionnaire - A student exit questionnaire was developed by the researcher and administered to participating students during the last week of the study. There were seven questions on the survey, asking students about their attitudes regarding math, the computer math lessons, and group activities. The survey was reviewed and approved by a group of education experts prior to administering the survey to students.

Procedure

At the beginning of the third week of school, the classroom teachers administered the pre-test to the students participating in the study. The test took two days to complete. Students completed the first part of the pre-test (computation) on the first day and the second part of the pre-test (concepts and applications) on the second day. Each student completed the pre-test individually.

Students scoring below the group median for the pretest were classified "low-achieving," students scoring at or above the median were classified as "high-achieving." This provided 32 students in the low-achieving group and 33 students in the high-achieving group. Students in one of the three fifth grade classes were randomly assigned to the individual learning (control) group, and students in the other two classes were assigned to the cooperative (experimental) group.

For the two experimental classes, each student was randomly paired with another student in their class. Thus, since there were 44 students in the experimental classes, a total of 22 cooperative groups were formed. These student pairs then received training on cooperative learning and group interaction. All student teams completed the training prior to starting their work on the computers. The 21 students in the control class did not receive any training.

At the beginning of the fourth week of school, all students participating in the study started working on the computer lessons. Students in the experimental group worked on the lessons with their partners, while students in the control group worked individually on the lessons. Students worked on the computer math lessons one time a week for 50 minutes each session. Students in the experimental group worked with their partners for the entire 50 minutes. The classroom teacher and lab assistant were present in the lab during each session.

Students in both the experimental group and the control group were observed by the researcher during their mathematics lab time each week throughout the study. The purpose of the observations was to collect anecdotal and qualitative data regarding student actions and work habits in the computer lab. The researcher observed for 30 of the 50 minutes of each session, allowing the first 10 minutes for students to move to their assigned seats, log in, and begin working, and the last 10 minutes for students to print their results and save their work.

The researcher used a pre-developed observation form to record any student comments or questions towards the teacher or lab assistant, student comments to themselves or their partners, and the frequency with which each student or group requested assistance from the teacher or lab assistant. In collecting these data, the researcher observed from an unobtrusive location in the computer lab. The researcher never interacted with the students during observations. Occasionally, the researcher would ask the teacher or lab assistant for clarification on interactions that took place. The researcher met with the computer lab assistant at the end of each week to discuss potential interaction problems with the student pairs, and to obtain feedback regarding the performance of the students in the lab.

All students participating in the study were also asked to complete attitudinal questionnaires during the final week of the study. The questionnaire asked students questions dealing with their attitudes towards mathematics, the computer math lessons, and working in cooperative groups. The questionnaires were administered to the students in the computer lab by the lab assistant.

Students in the study worked on computerized math lessons once a week for a period of 11 weeks. At the end of the treatment period, the students participating in the study were given a post-test using the mathematics portion of form B of the CAT/5. The protocol for administration of the post-test was identical to that of the pre-test. As with the pre-test, each student completed the post-test individually.

RESULTS

Achievement Test Data

A summary of posttest means and adjusted means is provided in Table 1. Student pretest results showed no significant differences between the experimental group and the control group.

Table 1.
Mean Adjusted Posttest Scores for Achievement Tests by Group and Achievement Level.

Group	Achievement Level		
	Low	High	Total
Experimental			
M	56.10	51.61	53.75
Unadj. Mean	43.71	62.17	53.36
Control			
M	48.50	49.67	49.14
Unadj. Mean	40.18	59.80	49.52

The adjusted mean for students in the experimental group ($\underline{M}$ = 53.75) was significantly higher than the adjusted mean for students in the control group ($\underline{M}$ = 49.14), $F(1,64) = 4.76$, $\underline{p} < .05$ (see Figure 1). The group X ability level interaction effect showed the greatest disparity of scores between the low-ability students in the experimental group and low-ability students in the control group. The adjusted mean for students in the experimental/low-ability group was 56.10, whereas the adjusted mean for students in the control/low-ability group was 48.50 (see Figure 2). However, this difference was not significant, $F(1,64) = 1.67$, $\underline{p} = .20$.

Figure 1.
Adjusted Posttest Scores by Group.

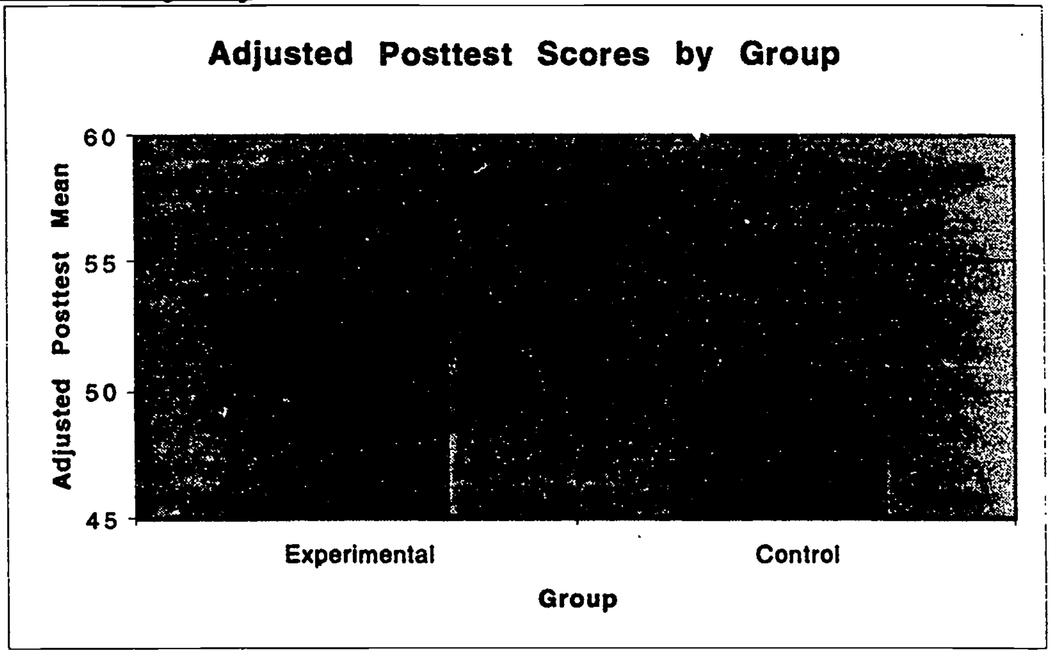
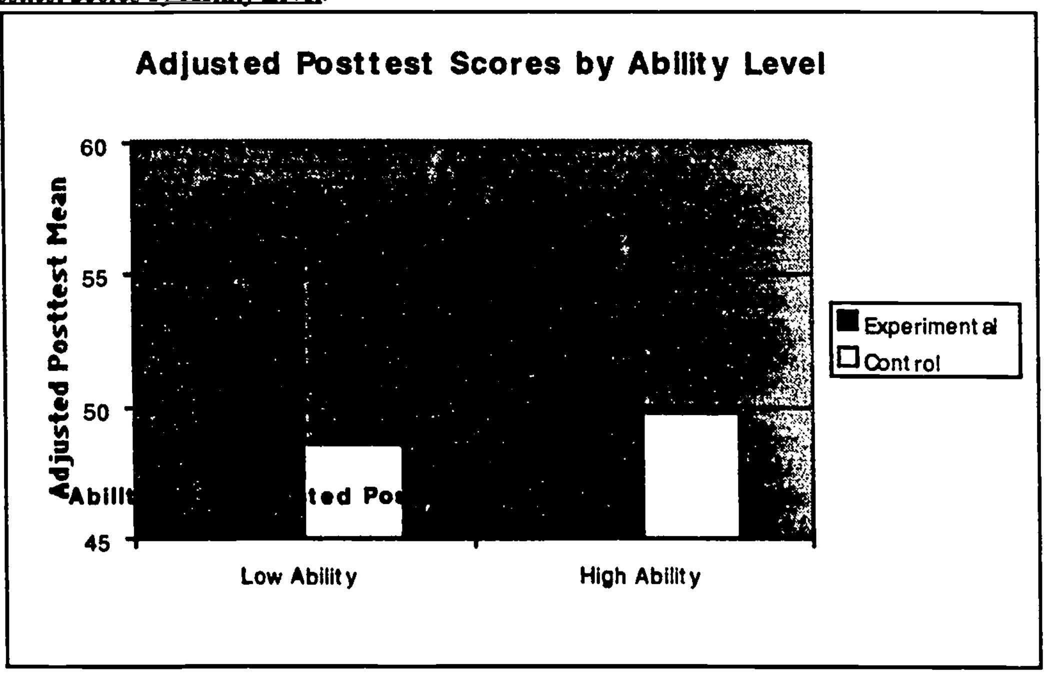


Figure 2.
Adjusted Posttest Scores by Ability Level.



Questionnaire Results

Responses to the questionnaire revealed attitudinal differences between students in the control group and students in the experimental group, particularly in terms of attitudes towards math and the computer math lessons. Refer to Table 2 for a summary of the questionnaire results.

Table 2.
Student Exit Questionnaire Results.

Questionnaire Statement	Student Responses	
	Experimental	Control
1. Do you like math?	Yes = 91%	Yes = 57%
2. Do you think you do well in math?	Yes = 86%	Yes = 76%
3. Do you like the computer math lessons?	Yes = 94%	Yes = 43%
4. Do the computer math lessons help you witn your math classwork?	Yes = 85%	Yes = 62%
5. Do the computer math lessons help you with your math homework?	Yes = 73%	Yes = 48%
6. Would you rather work on the math lessons alone or with a partner?	Partner = 68%	Partner = 76%

On the statement dealing with math attitudes (question 1), 91% of the students in the experimental group responded that they liked math, as opposed to 57% in the control group. A chi square test of these data revealed significant differences, $\chi2\ (1, N = 65) = 10.13$, $p < .002$.

In terms of the computer math lessons (question 3), 94% of the students in the experimental group responded that they liked the computer math lessons, as opposed to only 43% in the control group. Once again, a chi square test revealed significant differences, $\chi2\ (1, N = 65) = 20.28$, $p < .001$.

In addition, students in the experimental group responded significantly more favorably than students in the control group when asked if they believed the computer math lessons helped them with their math classwork and homework. Eighty-five percent of the students in the experimental group responded that they believed the computer math lessons helped them with their math classwork (question 4), as opposed to 62% of the students in the control group, $\chi2\ (1, N = 65) = 3.94$, $p < .05$. Seventy-three percent of the students in the experimental group responded that they believed the computer math lessons helped them with their math homework (question 5), compared to 48% of the students in the control group, $\chi2\ (1, N = 65) = 3.92$, $p < .05$.

On the questionnaire statement dealing with working with a partner (question 6), 76% of the students in the control group stated that they would rather work on the computer with a partner, as opposed to 68% in the experimental group. These data were not statistically significant, however.

The attitudinal data were also analyzed using student ability level as a blocking variable. This analysis revealed no additional significant differences between the groups.

Computer Lab Observations

During each computer lab observation, the researcher recorded verbal comments made by students to other students, the teacher or lab assistant, or themselves. Comments recorded for students in the experimental group dealt mainly with group interactions. Examples of some of the comments recorded included phrases such as: "Do you agree? ", "If you're only watching me you're not going to learn!", "Pay attention!", "You do this one.", "Don't ask for help yet.", and "We've got to take turns!". In addition, the researcher noted that many of the questions asked by students in the experimental group dealt with the content in the computer math lessons (e.g., "We don't understand this problem.", "Do we need to add or multiply here?").

The comments made by students in the control group dealt mainly with students' frustration with the computer math lessons. A sample of some of their statements included: "Can I get a sledgehammer?", "I'm getting tired of this junk!", "I want to go home.", "I don't know and I don't care!", "I hate math.", "What time do we leave?", and "I'm stupid!".

In addition to recording students' comments, the researcher also collected anecdotal data regarding interactions between students working in cooperative groups, on-task and off-task behaviors exhibited by students, and interactions between students and the teacher or lab assistant. The researcher observed that students in the experimental group demonstrated behaviors designed to monitor each other and keep each other on task. For example, if one of the students in a cooperative group was not paying attention, the other student in the group would gain the student's attention, either through a verbal comment or a tactile cue (such as pulling on their shirt), and would re-engage them in the lesson. In this way, the members of the groups were observed assisting each other in remaining on-task and engaged in the instructional content.

Analysis of observational data of students in the control group revealed a different set of behaviors than those in the experimental group. Students in the control group repeatedly demonstrated off-task behaviors such as putting their heads down on the table and giving up, quitting out of the lessons before they were finished to work on writing or drawing activities, staring out the window, asking to go to the bathroom or go get a drink, and "guessing" on math activities just to get through the lessons. These types of behaviors were generally not exhibited by students in the experimental group. The lab assistant was repeatedly overheard explaining to students that they needed to ask for help when they were stuck on a problem, and not give up. It was apparent that some students in the control group had difficulty knowing when to ask for help.

DISCUSSION

The notion of combining ILS-delivered instruction with cooperative learning activities has not been widely studied. This research has shown that integrating cooperative learning with ILS-delivered instruction is an effective instructional strategy. Results of this study showed that students working on math activities delivered by an ILS performed better on tests of those activities when they completed the activities in cooperative pairs than when they worked on the activities individually. In addition, this study showed that combining a cooperative learning model with ILS instruction had a positive impact on student attitudes towards the instructional content.

There are a number of possible reasons for the significant achievement differences between the experimental group and the control group. One explanation is that students working in pairs were able to assist one another with the computer math activities, thus creating peer support structures within their groups (Mevarech, 1994). If one student in the pair did not understand the math concept being presented, the other student had the opportunity to explain the concept. Through this dialog, not only did students who did not understand the concepts receive additional instruction from their partners, but their partners may have been able to reinforce their own understanding of the concepts through explanation. If students working individually did not understand any of the concepts being presented, the alternatives were to either guess at the answer or ask the teacher or lab attendant for assistance. If they chose to ask for assistance, they generally had to wait for the teacher to finish helping another student, thus decreasing their on-task time further. If they chose to guess, then it was likely that they did not understand the concept and would have more difficulty understanding future concepts.

A second explanation is that students working in pairs tended to stay on task while working on the lessons, whereas students working individually were more likely to either be distracted from the math activities or stop working altogether. During computer lab observations, the researcher recorded that students in the control group demonstrated off-task behaviors such as putting their heads down on the desk or staring out the window. These behaviors were not observed in the experimental classes. By staying focused on the computer math lessons and engaged in the content of the lessons, students in the experimental group most likely learned more math concepts, and thus were able to perform better on the math achievement test.

Finally, it is likely that teachers were able to spend more time with and provide a higher quality of assistance to students working in cooperative groups than students working individually. Even though there were about the same number of students in each of the classes participating in the study, teachers for the experimental group classes had an easier time getting around to all the students that needed assistance. This is because (1) in the experimental classes, teachers could work with two students at the same time, whereas in the control class the teacher had to work with each student individually, and (2) there were fewer off-task behavior problems that required teacher intervention in the experimental classes. Thus, pairing of students allowed the teacher to spend more time with the students who needed help and thus provide a greater amount of small-group tutoring on difficult concepts. This may have been particularly effective for low-achieving students, who had a greater need for teacher intervention and guidance than high-achieving students.

Results of this study also demonstrated significant differences in attitudes towards both the content and the delivery system. As with the achievement results, a major contributor to the positive attitudes reported by students working in cooperative groups could be the support structure provided by the cooperative groups. Students working individually on the lessons were observed getting frustrated and upset with the computer math activities, whereas students working on the lessons in cooperative groups were observed helping one another stay focused on the activities. Without the availability of peer assistance, students in the control group had to struggle through the lessons alone. This isolation from their peers may have contributed to their dislike of the lessons and of math in general. Also, students in the control group possibly did not receive as much teacher support in the computer lab when they were having difficulty with the math activities, thus exacerbating their frustration and contributing to their lack of success in the lab. It is logical to assume that students would have negative attitudes towards activities in which they were not succeeding.

Limitations

Readers should be careful when interpreting the results of this study, and to take into account the following limitations which may have impact on the internal and external validity of these results:

1. Subjects and sample size - only fifth-grade students from one elementary school participated in this study. It may be difficult to generalize these results to other age-groups. For example, younger students may have had more difficulty interacting and staying on-task in cooperative group activities. In addition, only 65 students participated in this study. The researcher concedes that the results may have been more significant with a larger population participating, due to larger sub-groups and the increase in statistical power associated with a larger population.

2. Subject-matter - mathematics was used as the content area for this study. These results may not necessarily transfer to other subject areas such as language arts, science, or social studies. Writing activities, for example, generally take longer to complete than math problems and students may have more difficulty completing this type of activity in cooperative groups due to the personal nature of many writing activities.

3. Teaching styles - readers should be reminded that the control group consisted of all the students in one particular fifth-grade class, and that the experimental group consisted of students in two fifth-grade classes. The researcher concedes that this method of dividing the experimental group and the control group is not as experimentally sound as a true random dispersion of students due to confounding variables (such as the teacher) that could not be controlled. However, due to ethical considerations, the researcher felt that the method chosen was the best way of dividing the students. Students in each of the participating classrooms did not have the same teachers for math instruction. Thus, it was inevitable that different teaching styles, discipline strategies, and instructional methods would be used in the different classrooms. These differences in teaching styles during computer lab time most likely had some impact on the results of this study. Readers should take this into account when generalizing these results.

Conclusion

Research investigating both integrated learning systems and cooperative learning has shown them to have positive effects on academic achievement levels and attitudes of students. This study has revealed that combining an ILS delivery system with cooperative learning strategies can also facilitate the learning process.

There are several considerations that should be taken into account when combining cooperative learning and integrated learning systems. First, a learning area conducive to cooperative learning activities is important, particularly in a computer lab setting. Students need to be able to easily work together in their group without feeling cramped, and groups need to be separated from one another so that they do not distract each other. Second, teacher support in the computer lab is key to the successful combination of cooperative learning and ILS. Cooperative learning provides teachers with the opportunity to spend more time tutoring small groups of students. However, teachers need to take an active instructional role in the computer lab in order for this strategy to have the greatest impact on students. Teachers who take a passive, reactive role in the computer lab will most likely see that cooperative learning and ILS provides fewer positive academic benefits to their students. Finally, the activities students are completing using the ILS, whether those activities are completed in cooperative groups or individually, need to correspond to the concepts being taught in the classroom. If students learn new concepts in the computer lab, and those concepts are not reinforced in the classroom, then students will have difficulty remembering those concepts. Teachers need to use the instructional activities provided through the ILS to enhance and support their curriculum. Keeping classroom activities and computer lab activities separate and distinct will diminish the effectiveness of the instruction provided in both settings.

The results of this study suggest to educators that using cooperative learning strategies in a computer lab setting can have greater benefits than increased standardized achievement test scores. Although test results did reveal significant differences between the experimental group and the control group, the differences between the groups were greater than those measured by a test. Student behaviors appeared to be markedly different, and the enjoyment and excitement observed in the experimental classes was not as noticeable in the control class. These behavior differences should encourage educators to look beyond simple test scores in order to determine the full merits of this strategy.

This study provides evidence that an instructional strategy that research has demonstrated as effective with different populations of students can be effectively integrated into a ILS lab setting. Based on these results, educators may want to consider experimenting with the use of other instructional strategies in ILS labs. Combining different strategies with ILS instruction will definitely be more effective then continuing to use ILS labs as reinforcement tools or as instruments to passively feed instruction to students. An integrated learning system is a powerful tool in its own right when used properly. Utilizing effective instructional strategies such as cooperative learning with an ILS can make that tool even more powerful.

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