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ABSTRACT

The purpose of this study was to investigate the effects of using individual, cooperative-dyad, and collaborative-dyad learning structures with a computer simulation. College students implemented and experienced one of the three learning structures while using a computer simulation designed to teach the technical and procedural aspects of accounting. Results indicated that performance scores were high, and time on task similar, regardless of learning structure; however, students who worked alone expressed significantly more continuing motivation for their learning structure than students who worked with a partner. Responses to student interviews revealed somewhat mixed feelings for the small group structures. More than 60% of the student overall commented that they would enjoy working with a partner, but less than 50% said they thought they would learn more with a partner. Observation of the small groups indicated that students in the cooperative dyads exhibited significantly more discussion and provided more answers to their partners' questions than students in the collaborative dyads. Implications for implementing small group structures with computer-based instruction are provided, and two tables summarize student responses. (Contains 25 references.) (Author/SWC)

Title:

The Effects of Learning Structures on Student Achievement and Attitude Using a Computer Simulation

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Abstract

The purpose of this study was to investigate the effects of using individual, cooperative, and collaborative learning structures with a computer simulation. College students implemented one of the three learning structures while using a computer simulation designed to teach the technical and procedural aspects of accounting. Results indicated that performance scores were high regardless of learning structure. However, students who worked alone expressed significantly more continuing motivation for their learning structure than students who worked with a partner. Responses to student interviews revealed somewhat mixed feelings for the small group structures. Furthermore, observation of the small groups indicated that students in the cooperative dyads exhibited significantly more discussion and provided more answers to their partners' questions than students in the collaborative dyads. Implications for implementing small group structures with computer-based instruction are provided.

Implementing Individual and Small Group Learning Structures with a Computer Simulation

There has been a great deal of interest recently in implementing small group learning structures in a variety of educational settings. The success of small group methods in classrooms (cf. Johnson & Johnson, 1989; Sharan, 1980; Slavin, 1990) has prompted educational technologists to examine the effect of employing small group strategies with computer-based instruction (CBI). According to Johnson, Johnson & Stanne (1985), small group structures reduce the social isolation inherent in the design of most CBI by providing students the opportunity to discuss what they are learning.

A number of research studies have been conducted to examine the effect of implementing small group methods with CBI. Some researchers have found that student achievement and attitude increases when small group strategies are used with CBI (Dalton, Hannafin, & Hooper, 1989; Hooper, Temiyakarn, & Williams, 1993; Johnson, Johnson, & Stanne, 1985; Schlecter, 1990). However, others have reported that individual and small group structures are equally effective when employed with computer instruction (Carrier & Sales, 1987; Orr & Davidson, 1993).

The mixed results for using small groups with CBI might be due to the type of small group method implemented in these studies. Two of the most frequently used small group methods are cooperative and collaborative learning. While both share similar elements, Smith and MacGregor (1992) have indicated that these methods can be placed into distinct categories of learning approaches that require joint intellectual effort. These categories are based on the structure required for each method.

Cooperative learning is the most highly structured of all small group methods (Smith & MacGregor, 1992) and has been defined as students working together on tasks that require interdependent goals and rewards (Smith, 1989). Cooperative learning activities are structured to include positive interdependence, face-to-face interaction, interpersonal and group skills, and individual accountability (Johnson & Johnson, 1988). Furthermore, group rewards are often provided to promote cooperation among students (Slavin, 1991).

Small group methods such as peer collaboration require less structure than cooperative learning (Davidson, 1985, Smith & MacGregor, 1992). Damon and Phelps (1989) have indicated that the two elements of equality and mutuality distinguish collaboration from cooperation. Equality is achieved when students with similar abilities work to help each other learn. Mutuality is influenced by the structure of a task when groups are required to work together. Division of labor structures, found in many cooperative settings, are low in mutuality since each student can work alone without exchanging information. Peer collaboration establishes a more mutual status than cooperative learning (Damon & Phelps, 1989).

The purpose of the current study was to investigate the effects of implementing cooperative, collaborative, and individual learning structures with a computer simulation in accounting. The Accounting Education Change Commission has recommended the addition of several instructional methods to accounting curricula, including active student participation, small group work, and the creative use of technology (ACC.; 1990). The accounting simulation used in this study was designed for an ACC. grant awarded to the School of Accountancy in 1991. The course designers and faculty wanted to determine if small group learning structures recommended by the ACC. (1990) were as effective as the individual learning structure originally implemented with the computer simulation.

There is very little research on using small group learning methods or computer-based technology in accounting education. A recent study by Ravenscroft, Buckless, McCombs, & Zuckerman (1993) indicated that college students in an introductory accounting course who worked in teams achieved higher grades than students who worked individually. However, no differences were found for students enrolled in a course on auditing. Furthermore, Oglesbee, Bitner, and Wright (1988) reported that students enrolled in an introductory accounting course who used CBI performed better than those in a lecture format. However, those results disappeared once the researchers controlled for prior achievement.

Method

Subjects

Subjects for the study were 105 college students (63 females, 42 males) enrolled in an accounting course at a large southwestern university. All subjects were completing prerequisite requirements for entry into an upper division, professional program in the College of Business. Students had completed a first semester course in introductory accounting with a grade of B or better. They were concurrently enrolled in a second semester introductory accounting course and in a computer laboratory course. The study was conducted in this computer lab.

Materials

The materials used in this study were a computer simulation designed to teach students the technical and procedural aspects of accounting and a set of student booklets designed to facilitate the implementation of the simulation in either an individual, cooperative or collaborative environment.

Computer simulation. The computer simulation, entitled An Introduction to Accounting: A Business Simulation (Birney & Smith, 1994), was designed using the framework of an accounting firm. All treatment groups used the computer simulation without any variations in the program. It provided pre-instruction, information, practice, and feedback on the topic of how to prepare adjusting journal entries.

In the simulation, each student was an employee of an accounting firm and reported to his or her office to begin each computer session. Once in the office, the employee's "desk" contained many tools such as a pop-up calculator, a FAX machine for messages from clients, computer E-mail for messages from the boss, and a calendar. The laboratory assignments were listed on the employee's calendar, which directed a student to the tasks to be performed and the order of completion for the tasks. Tasks that were completed showed a red check mark next to them.

The first part of the simulation was a tutorial session providing information and examples about how to prepare adjusting journal entries. Content and example screens were followed by 28 practice items which included fill in the blanks, numeric calculations, true or false statements, and constructed response (journal entry preparation and T-account analysis). The exercises required a student to use and apply various skills and knowledge in order to complete the next two parts of the simulation designated as practice sets.

Both practice sets were presented through a business simulation. At the beginning of each simulation, a pop-up calendar appeared on the screen, showing a list of the clients' books that needed to be adjusted (Queng Heating Co. and Holt Laundry). Both practice sets required a student to make decisions about the need for adjustments to the clients' books, to prepare accrual or deferral adjustments, to observe the posting of the adjustments, and to prepare an adjusted trial balance.

The format design of both practice sets included four steps. First, a memo from the client was shown on the screen listing various transactions that had occurred for the client's business. The instructions asked the student to select the transactions which would require adjustments. Next, the computer simulation displayed various internal and external documents pertaining to the transactions which the student reviewed in the memo. The instructions asked the student to prepare the necessary adjusting journal entry for each source document. The third step instructed the student to post the adjustments to the general ledger. The fourth step showed the student the various posted accounts from the general ledger and instructed them to prepare an adjusted trial balance.

A practice exam followed the second practice set. This exam included 21 items which were similar in content and design structure to the tutorial and simulation practice exercises. The practice exam was scored by the computer and constituted 10% of a student's grade. After the practice exam, the computer provided a review of questions that the student answered incorrectly. This review provided both the right answer and an explanation of why that answer was correct.

Student booklets. Three different student booklets were designed to provide directions and procedures to implement an individual, cooperative, or collaborative learning structure. The basic design for each booklet was a content and activity outline of the computer module for Preparing Adjusting Entries. In addition, different prompts were printed on the booklets to help students consistently utilize treatment-specific instructions.

The booklet for the individual treatment group included a set of instructions describing the procedures each student was to follow in the computer lab. It directed students to work individually on each part of the simulation. The booklet included generic prompts in the introduction such as "use the space provided in your booklet to note any questions you have about the material." It also supplied procedural prompts throughout the booklet such as "you are now ready to start working on Practice Set I."

The booklet for the cooperative treatment group included a set of instructions describing the procedures each student would follow in a cooperative dyad. The introduction explained that students would take turns performing the role of preparer and checker. The duties of each role were described in the introduction; students were informed that the preparer should "do the work at the keyboard" and the checker should "check the work and provide assistance as needed." The booklet included procedural prompts throughout to remind to frequently rotate their roles and to ensure that each member of the dyad would practice the skills and knowledge included in the simulation. The booklet also reminded students to shift the mouse and keyboard over to the preparer each time there was a switch in roles.

The booklet for the collaborative treatment group included a set of instructions describing the procedures each student would follow in a collaborative dyad. The introduction provided general directions such as "work by yourself at your own computer and make notes of questions you want to discuss with your partner." The booklets also included procedural prompts throughout which directed students to work alone during designated portions of the lesson, make notes of questions to ask their partner, and discuss these questions with their partner at specified times during simulation.

Procedures

This study was implemented over a two week period in a computer laboratory as part of required course activities. Prior to the study, students were informed that they would participate in a research study and that extra credit would be awarded to students who attended each of the four, 75 minute class sessions.

Several weeks before the study, seven intact classes were randomly assigned to either the individual, cooperative, or collaborative treatment conditions. Before assignment to treatments was made, test scores from the first course examination were collected and analyzed to established equality between the classes. A one-way analysis of variance of these scores revealed no significant difference between classes for prior achievement. The following section describes the procedures followed by subjects in each of the treatments.

Individual treatment. Students working individually followed the standard lab format for the class. On Day 1, each individual received a student booklet and were told to note where they stopped at the end of each lab session. Students then worked alone on the computer simulation. On Day 2, individuals received their booklets as they entered the lab and were instructed to proceed with the simulation. On Day 3, individuals were told that they should finish the simulation by the end of the day. Students completed the practice exam and review after practice set 2. On Day 4, students completed a pencil and paper posttest and then entered their answers on the computer. Immediately following the posttest, students completed an attitude survey. Twenty-eight students from the individual treatment participated in an interview about the study after they completed the posttest and attitude survey.

Cooperative treatment. Students in this treatment condition used a cooperative learning structure suggested by Kagan (1989). This strategy required two students to work together to complete the simulation, alternating the roles of preparer and checker. Positive interdependence was achieved through the structured tasks each partner had to perform, and by providing the mutual goal of reaching consensus on a solution. In addition, the pair received the same grade on the practice exam, which constituted 10% of their total unit grade.

On Day 1, students were randomly assigned to a dyad; each dyad was assigned to a computer. Students were informed that they would receive the same score for the practice exercises and practice exam. Each student was given a booklet and told to note where they stopped at the end of each lab session. Students then worked cooperatively on the computer simulation. On Day 2, each student received their booklet and were reminded to switch roles as prompted. On Day 3, dyads were again reminded to switch roles and were told that they should finish the simulation by the end of the day. Dyads completed the practice exam and review together after practice set 2. During the practice exam, students were preparers for half of the questions and checkers for half of the question. On Day 4, each student individually completed a pencil and paper posttest and then entered their answers on the computer. Immediately following the posttest, each student completed an attitude survey. Twenty-nine students from the cooperative treatment participated in an interview after they completed the posttest and attitude survey.

Collaborative treatment. Students in this treatment condition used a collaborative learning strategy while completing the simulation. Each dyad member individually worked through one part of the simulation at a time and were directed to note questions or concepts they wanted to discuss with their partner. Students were prompted at specified points in the lesson to consult with their partner to discuss these questions. Positive interdependence was achieved by structuring activities so that students would benefit from sharing their ideas and responding to other's questions and comments.

On Day 1, students were randomly assigned as dyads to computers that were adjacent to each other. Each student was given a booklet and told to note where they stopped at the end of each lab session. Students then worked collaboratively on the computer simulation. On Day 2, each student received their booklet and were reminded to individually complete part of each practice set and then consult using the notes they made in the booklet. On Day 3, students were again reminded to use the collaborative method and were told that they should finish the simulation by the end of the day. Students individually completed the practice exam and review after practice set 2, and then collaborated with their partner on notes they made during the practice exam. Each student received an individual grade on the practice exam. On Day 4, each student individually completed a pencil and paper posttest and then entered their answers on the computer. Immediately following the posttest, each student completed an attitude survey. Thirty students from the collaborative treatment participated in an interview about the study.

Criterion Measures

Criterion measures for this study were student achievement, attitude, time on task, student interactions, and responses to student interviews.

Achievement was measured using a 35 item, paper and pencil posttest designed to assess student mastery of the skills taught in the computer simulation. The test items were of a similar nature to the tutorial and practice set items and asked for knowledge answers, numeric calculations, true or false choices, and constructed responses. There were 21 selected response items and 14 constructed response items on the posttest. The KR-21 reliability of this test was .75.

Attitude was measured using an eight item, paper and pencil survey. Students used a five point, likert-type scale (1 = strongly agree, 5 = strongly disagree) to record their responses to the following items:

1. The unit was interesting.
2. I learned a lot from this unit.
3. I did well on the posttest.

4. I like working alone/with a partner.
5. I learn more working alone/with a partner.
6. I would take other courses structured like this one.
7. The grading for this unit was fair.
8. I am very comfortable using computers.

The attitude survey was administered immediately after the posttest. The Cronbach alpha reliability of this survey was .76.

Time on task was tracked by the computer simulation which captured the amount of time students spent on the tutorial, both practice sets, and the review.

The number of student interactions exhibited by dyads in the cooperative and collaborative learning structures were observed and recorded on an observation sheet. This observation sheet included interaction behaviors that other researchers have suggested as necessary for successful group work (Klein & Pridemore, 1994; Webb, 1982, 1987). These interaction behaviors were grouped into five categories of questioning (asking a question), answering (answering a question), encouraging (giving praise or unsolicited help), discussing (talking about content or task), and off-task (verbal and non verbal behaviors). Trained observers were stationed among four dyads to observe each dyad and record observations at approximately two minute intervals during the first, second, and third lab periods. The observers watched each dyad for five minute intervals during the fourth lab period. During a pilot study, three observers watched the same dyad for several two minute intervals and recorded their behaviors. Reliability was based on all three observers having similar totals for this dyad. The inter-rater reliability between observers was .85.

Student interviews were conducted using a five question, written interview protocol. Questions about the computer lesson and learning structures were based on student responses obtained from interviews conducted in the pilot study. Students volunteered to participate in these one-to-one interviews. They were conducted by one interviewer after each student completed the posttest and attitude survey. Approximately 84% of the students who participated in the study (87 out of 105) volunteered to be interviewed.

Design and Data Analysis

This study used a posttest only, control group design with the one independent variable of learning structure (individual, cooperative and collaborative). The dependent variables included student achievement, attitudes, time on task, student interactions, and responses to interviews.

A one-way analysis of variance (ANOVA) was conducted on the posttest data. ANOVA was also conducted on data for overall time on task and time spent on each section of the simulation. Separate 3 (learning structure) X 5 (item selection) chi-square analyses were conducted for each item on the attitude survey. The number of interactions exhibited by students in the cooperative and collaborative treatments were totalled and categorized as questioning, answering, encouraging, discussing, and off-task. Separate chi-square analyses were conducted on each category of interaction behaviors. Finally, responses to student interviews were summarized and reported as percentages.

Results

Student Achievement

The mean posttest achievement score was 31.30 for students in the individual learning structure, 31.19 for students in the collaborative learning structure, and 30.94 for students in the cooperative learning structure. Student performance across all groups was 31.14 or 89%. ANOVA indicated that the difference between the treatment groups on the posttest was not statistically significant.

Student Attitudes

Student responses to the attitude items revealed that most students thought that the unit was interesting (76 out of 105; M = 2.12) and believed that they learned a lot from it (86 out of 105; M = 1.98). In addition, most students thought that they did well on the posttest (71 out of 105, M = 2.13), that the grading for the unit was fair (88 out of 105, M = 1.97), and that they were very comfortable using computers (85 out of 105, M = 1.86).

Separate 3 (learning structure) X 5 (item choice) chi-square analyses were conducted for each item on the attitude survey. These analyses indicated a significant difference between the learning structures on one of the eight attitude items. Chi-square indicated a significant difference for the item "I would take other courses that were structured the same as this one," $X^2 = (8, N = 105) = 14.49$, $p < .05$. Data revealed that 70% of the students in the individual learning structure agreed or strongly agreed with this item, compared to only 36% of the students in the cooperative structure and 22% in the collaborative structure. In contrast, only 12% of the students in the individual learning structure disagreed or strongly disagreed with this item, compared to 42% of the students in the cooperative structure and 28% of the students in the collaborative structure.

Time on Task

Time data revealed that the average number of minutes spent on the entire simulation was 140.18 for students who worked alone, 145.44 for students who worked cooperatively, and 144.15 for students who worked collaboratively. ANOVA indicated that the differences between these means was not statistically significant.

In addition to overall time spent on the simulation, data were collected for the amount of time students spent on the tutorial, both practice sets, and the review. These data indicated a significant difference between treatments for the review portion of the simulation, $F(2,102) = 3.40$, $p < .05$. The average number of minutes spent on review was 5.31 for students who worked alone, 11.35 for students who worked cooperatively and 7.25 for students who worked collaboratively. Post hoc analysis using Tukey HSD pairwise comparisons revealed that students who worked cooperatively spent significantly more time on review than students who worked alone, ($p < .05$).

Student Interactions

Table 1 summarizes the number of student interactions exhibited by dyads in the cooperative and collaborative learning structures. These interaction behaviors were grouped into five categories of questioning, answering, encouraging, discussing, and off-task behaviors. Chi-square analyses were performed on each of the five different behaviors to determine the influence of learning structure. These analyses indicated a significant difference between cooperative and collaborative learning structures on two of the five behaviors. Students in cooperative dyads exhibited a total of 459 discussion behaviors while those in the collaborative dyads exhibited 218 discussion behaviors, $X^2 = (1, N = 36) = 12.29$, $p < .001$. Students in cooperative dyads also provided significantly more responses to their partners' questions (194) than students in the collaborative dyads (136), $X^2 = (1, N = 36) = 10.19$, $p < .01$.

Responses to Student Interviews

Table 2 provides a summary of student responses to the five interview questions. These data suggest that the majority of students responded that the simulated practice sets were the most helpful feature of the computer lesson. Seventy-nine percent of individual subjects, 48% of cooperative subjects, and 57% of collaborative subjects listed the practice as the most helpful aspect of the lesson.

Participants were also asked what aspects of the student booklets were helpful. Thirty-six percent of individual subjects, 55% of cooperative subjects, and 43% of collaborative subjects listed the organization and instructions as most the most helpful feature of the booklets. However, 57% of individual subjects, 45% of cooperative subjects, and 43% of collaborative subjects indicated that they di l not use the booklets throughout the entire lesson.

Responses to questions about learning structure revealed that 57% of individual subjects, 52% of cooperative subjects, and 43% of collaborative subjects indicated a preference for working alone over working with a partner. Finally, 71% of individual subjects, 62% of cooperative subjects, and 60% of collaborative subjects responded that working with a partner would be more enjoyable than working alone. However, only 46% of individual subjects, 38% of cooperative subjects, and 40% of collaborative subjects said they would learn more working with a partner.

Discussion

The purpose of the current study was to investigate the effects of using cooperative, collaborative, and individual learning structures with a computer simulation. College students enrolled in an accounting course implemented one of the three learning structures while using a computer simulation to learn how to prepare adjusting entries to close clients' books.

Results indicated that scores on the performance test were high regardless of learning structure. The average achievement score was 89% for subjects in all three treatments. This result is likely due to the students who participated in the study. Prior to this study, all subjects had completed an introductory accounting course with a grade of B or better; most indicated that they would pursue a college major in accounting. Furthermore, scores from a test given prior to the study suggested that subjects had a high degree of ability to perform tasks similar to those taught in the computer simulation. It is likely that these students would perform well regardless of their placement in an individual or small group learning structure.

This explanation is consistent with results found by other researchers. Ravenscroft et al.(1993) found that small group learning increased scores of students in an introductory accounting course, but did not influence performance in an advanced course on auditing. Oglesbee, Bitner, and Wright (1988) reported that prior achievement had a strong influence on scores in an accounting course regardless of the medium used to deliver instruction.

Results for time on task indicated that students spent the same amount of overall time working on the simulation regardless of learning structure. In addition, no differences were found for time spent on the tutorial and on both practice sets. However, cooperative subjects did spend significantly more time on the review portion of the lesson than subjects in the other learning structures. One possible explanation for this finding is that students in the cooperative learning structure felt that the benefits of review would increase because of additional discussion and elaboration of the content.

The result that small group subjects did not spend more time than individual subjects on the simulation is not consistent with other cooperative learning studies. In fact, Slavin (1990) indicated, "most studies that have measured time on task have found higher proportion of engaged time for cooperative learning students than for control students" (p.47).

Observations of students in the individual learning structure may shed some light on why these students spent as much time on the simulation as those in the small group structures. These observations suggested that individuals frequently accessed the on-line reference book, which was bright red in color and noticeably visible on screens throughout the laboratory. This likely increased time on task for individuals.

While results suggested that the three learning structures were equally effective, findings from the attitude survey revealed that students who worked alone expressed significantly more continuing motivation for their learning structure than students who used the small group structures. Approximately 70% of students in the individual condition reported that they would take other courses structured like this one, compared to 36% of students in the cooperative condition and 22% in the collaborative condition.

Furthermore, responses to the interviews revealed somewhat mixed feelings for the small group structures implemented in this study. Results showed that 57% of individual subjects, 52% of cooperative subjects, and 43% of collaborative subjects indicated a preference for working alone rather than with a partner. While more than 60% of students in all three conditions reported that they would enjoy working with a partner, less than half of subjects in all conditions said they would learn more working with a partner. This is consistent with other researchers who found that some students like working in small groups even when their achievement does not increase (Palinscar & Brown, 1979).

The results of the current study may be explained by the elaborations provided by students during the interviews. Many of the subjects from the cooperative and collaborative treatments qualified their responses about small group structures with the conditions that 1) their partner should be a student who had a similar commitment level to school, 2) the subject should require thought and analysis rather than memorization, and 3) the class format should include in-class activities and instructor assistance on team formation and skills. They thought such a course must have "hard stuff, not self-explanatory stuff or stuff you just memorize" and that a "lab class isn't good (for small group structures) unless the computers are networked and you change the software."

Results from the interviews also suggest that approximately 44% of subjects in both small group structures did not consistently use the workbooks which were designed to prompt them to cooperate or collaborate. Observation of students in the small groups provided evidence that subjects used the workbook during Day 1 of the study, but tended to ignore the workbook on subsequent days. Students who elaborated their answer to the interview questions provided further evidence that the workbooks were not implemented as intended. Many students remarked that they only used the workbook to keep track of where they got to each day.

Even though they did not use the workbooks as directed, students in the small group conditions did exhibit interaction behaviors during the lesson. Using the workbooks during Day 1 of the lesson may have been enough to prompt these interactions. Prior experience in small group learning in the introductory accounting course also may have contributed to the occurrence of these interaction behaviors.

The results for student interaction were consistent with the design of the cooperative and collaborative learning structures. Students in the cooperative dyads exhibited significantly more discussion about the content and tasks than students in the collaborative dyads. Students in the cooperative structure also provided answers to their partners' questions significantly more often than those in the collaborative structure.

These differences can be attributed to the nature of the two small group structures under investigation. In the cooperative structure, students were told to assume specific roles of preparer and checker and to switch these roles frequently. Cooperative subjects also used one computer throughout the lesson. In keeping with Davidson's (1985) suggestions for how to design collaborative learning, the collaborative dyads were provided with less structure than the cooperative dyads. Students in the collaborative dyads each used their own computer and were directed "not to discuss as you go" but rather to wait and consult with their partner about their questions at specific points in the lesson.

Observations of each dyad for five minute intervals on the last day of the study confirmed that students in the cooperative and collaborative conditions exhibited different patterns of interactions. Many students in the cooperative learning structure talked aloud while working through the simulation, asked questions, and waited for agreement from their partner. Most exchanges of information went back and forth many times, as opposed to one sided comments. Many students in the cooperative dyads looked at each other when they spoke.

In contrast, students in the collaborative learning structure seemed to develop a non verbal signal of staring at their partner's screen when they needed to consult. Little eye contact or face to face conversations occurred. Most collaborative students spoke to their own computer screens when asking questions or giving answers. Comments were usually brief, one sided events.

The current study provides some implications for educational technologists who design and implement computer-based instruction. Results indicate that small group structures do not always increase student learning and motivation, especially for high functioning students. When computer resources permit each student to work at a computer, the investment of additional time to create small group learning structures may not be justified. In cases where learning objectives specifically include the mastery of group and social skills, the investment of time necessary to redesign the computer instruction for group use may be warranted. This study suggests that adjunct materials such as workbooks are not the best method of prompting students to work together when using computer instruction.

Since computer resources are often limited, educators are forced to group several students at one computer. Future research should be conducted to determine the most effective ways to enhance learning when students work in small groups at the computer. A recent study by Sherman & Klein (in press) indicates that embedded prompts can influence student interactions and achievement when cooperative learning is combined with computer instruction. Future research could explore embedded prompts in computer simulations. Research should also continue to examine different types of learning structures when students use computer technologies. Finally, future research should continue to explore the use of computer simulations in college classrooms to determine the most effective structures for implementing this technology into the curriculum. Such research can assist educational technologists in constructing the best combination of learning structure and tasks so that the learning experience is enhanced.

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Table 1

Number of Student Interactions for Cooperative and Collaborative Dyads

	Learning Structure	
Type of Interaction	Cooperative	Collaborative
Questioning	181	157
Answering	194	136
Encouraging	61	49
Discussing	459	218
Off task	21	21

Table 2

Summary of Student Responses to Interview Questions

What features of this computer lesson helped you learn?

	Ind	Coop	Coll
Simulated practice sets	79%	48%	57%
Working with a partner	0%	24%	40%
Booklets	18%	0%	0%
Everything	3%	28%	3%

What features of the student booklet did you find helpful?

	Ind	Coop	Coll
Didn't use booklet	57%	45%	43%
Organization/instructions	36%	55%	43%
All of it	7%	0%	14%

Do you prefer to work alone or with a partner to learn?

	Ind	Coop	Coll
Alone	57%	52%	43%
Partner	43%	38%	40%
Either is OK	0%	10%	17%

Do you think you would have learned more if you had worked alone or with a partner?

	Ind	Coop	Coll
Alone	43%	21%	27%
Partner	46%	38%	40%
Same with either	11%	38%	33%
Depends on subject	0%	3%	0%

Do you think you would have enjoyed this module more if you had worked alone or with a partner?

	Ind	Coop	Coll
Alone	29%	31%	37%
Partner	71%	62%	60%
Same with either	0%	7%	3%