GROUP QUIZZES: AN EXTENSION OF THE COLLABORATIVE LEARNING PROCESS*

Research has documented that collaborative learning groups improve student learning and increase the likelihood that students will have positive attitudes about both the subject matter and their peers. However, researchers know much less about how collaborative learning groups may influence student behavior and the extent to which their utility extends to testing as well as projects and papers. In an effort to address these gaps, we used quasi-experimental and survey data to examine the effects of collaborative testing on Introduction to Sociology students' learning, behavior, and attitudes. Findings indicate that collaborative testing improved students' behavior and attitudes. In comparison to a control group, students who participated in collaborative testing reported completing more of their assigned readings and had improved attitudes toward their learning, the testing process, and sociology.

SUZANNE R. SLUSSER
The University of Akron

REBECCA J. ERICKSON
The University of Akron

SOCIOLOGY INSTRUCTORS CONTINUALLY seek new methods to improve student success. One method that has begun to attract the attention of an increasing number of scholars is the use of collaborative learning groups (CLGs) (Longmore, Dunn, and Jarboe 1996; McKinney and Graham-Buxton 1993; Rau and Heyl 1990; Rinehart 1999). Much of the published work on CLGs describes the procedures for successfully conducting class exercises, most commonly research projects or papers. Despite the growing literature focusing on the use of this pedagogical strategy, few have conducted empirical tests of the effectiveness of group work on student outcomes.

In the literature on the scholarship of teaching and learning, researchers agree that using CLGs has a positive effect on learning as measured by student grades (Slavin 1990). However, we know less about how collaborative techniques influence other outcomes such as student behavior or attitudes. Moreover, few researchers have extended the use of CLGs beyond the typical "group project" format to examine their utility for test-taking or other learning and evaluation processes.

In this paper, we describe our use of a multi-method design to examine the effects of CLGs on student learning, behavior, and attitudes. Specifically, we compare the outcomes of students who used a collaborative learning process to complete in-class quizzes to the outcomes of those who took the same Introduction to Sociology course but who did not complete the quizzes collaboratively. Our findings indicate that in addition to having a positive effect on learning, collaborative testing may also lead to positive outcomes for student behavior and for attitudes about the course and the discipline of sociology.

THE OUTCOMES OF COLLABORATIVE LEARNING GROUPS

Although the use of collaborative learning

*The authors wish to thank C. André Christie-Mizell, Kathy Feltey, Betsy Lucal, John Zipp, and the anonymous *Teaching Sociology* reviewers. Please address all correspondence to Suzanne Slusser, Department of Sociology, The University of Akron, Akron, OH 44325-1905; e-mail: suzann9@uakron.edu.

Editor's note: The reviewers were, in alphabetical order, Steven Helmericks, Michael Polgar, and Jane Rinehart.

groups may have several benefits for students, positive outcomes are in no way guaranteed (Bouton and Garth 1983; Longmore et al. 1996; McKinney and Graham-Buxton 1993; Weitz 1995). In general, five characteristics of CLGs that are most likely to benefit student success are: (1) face-to-face interaction, (2) interdependence, (3) individual accountability, (4) social skills, and (5) group-processing (Johnson, Johnson, and Smith 1991).

First, for collaborative learning groups to be successful, they must be small enough to allow for face-to-face interaction so that each student has an opportunity to participate in the group process (also see Cohen 1994). Scholars generally recommend that groups should contain between two and four students in order for each student to have an opportunity to interact with others in the group (Millis and Cottell 1998). Second, collaborative learning groups must also create a sense of interdependence that holds students accountable to and for their peers (Campbell and Smith 1997; Johnson and Johnson 1990; Slavin 1990). Third, there must be a mechanism for holding students *individually* accountable for their contribution to the group (Johnson et al. 1991; Slavin 1985). Individual accountability encourages students to contribute to the process of achieving the group's goal and helps prevent them from "free-riding," or gaining benefits from the group without actively participating (Millis and Cottell 1998). Individual accountability also helps to prevent some students from becoming "workhorses" and doing a disproportionate amount of the work. Social skills constitute the fourth basic element of successful collaborative learning groups (Johnson et al. 1991). Developing a sense of group identity, trust, support, and accurate communication are examples of the social skills necessary for small groups to achieve positive results. The last element of successful CLGs is group processing – the opportunity for students to evaluate their own group's performance over a period of time (Johnson and Johnson 1990; Johnson et al. 1991).

Despite the demonstrated importance of the elements noted above, the extent to which these elements actually result in achieving an instructor's goals could depend on a number of other factors as well. For example, the effect of CLGs on student attitudes or behavior might be different than their effect on the more frequently measured learning outcomes (i.e., grades or other assessment techniques). The success of CLGs may also depend on group structure (Cohen 1994; Johnson et al. 1991; Millis and Cottell 1998) and the purpose for which these groups are used (e.g., papers, projects, exams, presentations, etc.). In terms of group structure, for example, CLGs that are heterogeneous by race, sex, and ability tend to result in more positive learning outcomes than those that are more homogeneous (Cohen 1994). This finding is particularly important because, due to time constraints, instructors often form CLGs using student self-selection. Because self-selection often results in groups that are homogeneous by race, sex, and ability, the use of such groups is likely to lead to fewer positive outcomes than might be possible were instructors to create heterogeneous groups (Campbell and Smith 1997; Cohen 1994). Most researchers who examine the effects of CLGs focus solely on learning outcomes. Past research suggests, however, that CLGs may also have a positive influence on student behavior and attitudes.

Learning

Collaborative learning groups have a well-demonstrated effect on learning. Most research on CLGs has examined their impact on student learning as measured by students' grades (Treisman 1985). For example, Slavin found when reviewing studies of cooperative learning that the effects on achievement were "clearly positive" (1990:18). Many researchers using collaborative learning compare it to the more traditional instructional method of lectures and report that students learn more in the collaborative learning groups (Dougherty et al. 1995; Johnson and Johnson 1994; Johnson

et al. 1991; Sharan 1980; Slavin 1983 and 1985). Based on a meta-analysis of over 280 studies, Johnson et al. (1981) reported that cooperative learning methods resulted in better student achievement than individualistic or competitive methods.

Although examining learning outcomes is clearly the preferred assessment technique for evaluating the effectiveness of CLGs, previous research suggests that CLGs may also contribute to other positive outcomes (Sharan 1980). For instance, researchers have shown that the use of CLGs leads students to evaluate their instructors more positively and may be associated with students engaging in such valued behaviors as completing the assigned reading and being prepared for class (e.g. Hoffman 2001; McKinney and Graham-Buxton 1993).

Behavior

Relatively few researchers have examined the relationship between participation in CLGs and students' study behavior. However, the few who have studied these relationships suggest that CLGs have the potential to improve students' study habits. Dougherty et al. (1995) found that when college chemistry instructors used collaborative learning methods in their courses, students reported that they spent more time studying with others than those in a control class that did not use collaborative learning techniques. Dougherty et al. also found that students in CLG classes spent more time reading text material than those in the control class. Although the exact mechanism remains unclear, collaborative learning groups may influence students' behaviors because of the presence of peers. Astin (1993) suggested, for example, that students in CLGs might spend more time and energy preparing assignments because they know that their peers will evaluate their work.

Attitudes

Collaborative learning groups may also have a positive effect on students' attitudes about a particular course and its subject matter (Campbell and Smith 1997; Helmericks 1993). For example, instructors report that students from CLG classes write comments that are more positive on their course evaluations than do those from classes taught more traditionally (Helmericks 1993; Hoffman 2001; McKinney and Graham-Buxton 1993). Compared to the literature documenting the effect of CLGs on learning, relatively little research has been conducted on the effect of CLGs on student attitudes. Nonetheless, Cooper and Mueck (1990) concluded their review of CLG outcomes by noting that attitudinal changes have been among the most consistent findings.

By definition, CLGs involve peer interaction. Such interaction has the potential to improve students' relationships with one another (Hansell and Slavin 1981; Sernau 1995; Slavin and Oickle 1981). As a result, CLGs may not only improve student achievement, but may also contribute to college-student retention. Campbell and Smith (1997) noted that student-peer relationships are among the most influential factors affecting student success and retention. Tinto (1994) identifies the failure to connect with student peers and the failure to participate academically in classes as the major reasons for dropping out of college. Also, Astin's (1993) longitudinal study of over 27,000 college students found that interactions among students and between faculty and students were the only two elements that influenced outcomes such as student achievement. These results suggest the need for further systematic research on the potential for CLGs to positively influence college students' attitudes about their learning experience and, potentially, to have an indirect effect on student retention.

COLLABORATIVE TESTING

Instructors have traditionally used CLGs for class discussion (McKinney and Graham-Buxton 1993; Weitz 1995; Zapalska and Perry 2002), completion of projects (Hoffman 2001; Longmore et al. 1996), papers (Hoffman 2001), and presentations

(Hoffman 2001). Far fewer instructors have used CLGs for the completion of quizzes or exams, a process referred to as collaborative testing (cf. , Cortright et al. 2003; Helmericks 1993).

The research that does exist suggests collaborative testing may yield several benefits for students. Collaborative testing may improve student learning and retention of material as well as reduce test anxiety (Cortright et al. 2003; Helmericks 1993; Rao, Collins, and DiCarlo 2002). Using control and experimental groups, Rao et al. found that physiology students who completed quizzes using collaborative groups earned higher grades than those who completed them individually. Cortright et al. (2003) reported that using CLGs for the completion of exams not only improved student learning in terms of grades, but also improved the students' retention of course content. In this case, half of the students in a physiology class were allowed to complete their exams in collaborative groups following an initial period of individual work. The other half completed the exam individually. Cortright et al. (2003) found that students using the CLGs scored higher on the exams than those in the control group. This result held not only for the exam on which they were able to obtain input from other group members, but also on a retest that they completed individually four weeks later. These results suggest that collaborative testing may be an effective strategy for improving student learning and, potentially, for the retention of course content.

The recent work of Rao et al. (2002) and Cortright et al. (2003) has clearly extended social scientific knowledge of collaborative processes. However, like others who have researched CLGs more generally, they did not examine the effects of collaborative testing on student attitudes or behavior. In an earlier study of sociology students taking a statistics course, Helmericks (1993) found that collaborative testing did have a positive effect on students' attitudes. He reported that allowing students to discuss test problems in four-person groups not only led to a reduction in test anxiety but also led to more positive course evaluations. In discussing his results, Helmericks suggested that the collaborative process strengthened the interpersonal ties among students and created a sense of mutual trust that enhanced the learning experience. Such findings indicate that obtaining further information about how collaborative testing affects students' attitudes and course-related behaviors may provide further evidence regarding the utility of this process for student success.

Our study examined the outcomes of CLGs when applied to testing. Based on the literature reviewed above, we expected that participating in a collaborative quiz-taking process would positively affect students' learning, behavior, and attitudes. First, we expected that students participating in collaborative testing (i.e., the experimental group) would learn more, when compared to a control group, as evidenced by higher quiz scores, higher exam scores, and higher final grades. Second, we also expected that those participating in collaborative testing would report that they were more likely to come to class having completed the assigned reading than those in the control group. Third, we expected that the experimental group, in comparison to the control group, would express more positive attitudes about the use of "pop" quizzes, how the quizzes were likely to affect their final grade, and about the field of sociology. Finally, we explored the extent to which student attitudes about the quiz process changed over the course of the semester. We were interested to learn whether students' initial skepticism about collaborative testing diminished as they gained more experience with the process (see Helmericks 1993).

METHODOLOGY

We collected quasi-experimental and survey data from students enrolled in two Introduction to Sociology classes. The second author served as the instructor for both classes and the first author served as teaching assistant

(TA) in both classes. The instructor, course content, and course structure were identical for each class except that the students in the "experimental" class participated in a collaborative testing process for completing their in-class quizzes.

After the initial distribution of the syllabus, the instructor briefly spoke about how the sociological perspective differs from other perspectives with which students might be more familiar (e.g., psychological). She then went on to discuss how sociology is "the scientific study of the interactions and relations among human beings" (McIntyre 2002:2). In the experimental class, this brief discussion about human interdependence provided some initial background for the instructor's description of the collaborative quiz-taking process.

As the instructor described the course requirements presented in the syllabus, she informed students in both classes that they would be required to complete eight unannounced quizzes focusing on the assigned reading for that day. She further informed the students in the experimental class that after working on the quizzes individually they would be allowed to discuss their answers in small groups (McKinney and Graham-Buxton 1993). The instructor then explained that following the group discussion she would select one quiz from a randomly selected member of each group. We told the students that although we would grade all quizzes, only the grade earned on the randomly selected paper would be recorded and counted toward each group member's course grade. In actuality, the instructor recorded all of the grades earned by the students, both individually and in their groups. The instructor referred back to the idea of interdependence and relationships in the context of such seemingly individual achievements as course grades. She explained that while we, as unique individuals, like to believe that our achievements are "individual" accomplishments, they are often the result of our relationships with others through social statuses, roles, groups, and institutions (Schwalbe 2001).

Using the grade point averages of each student in both classes, we created groups that, while heterogeneous, had similar levels of academic achievement (Cohen 1994; Campbell and Smith 1997). Anticipating the attrition that often occurs in introductory courses, we did not determine groups until the second week of classes and we initially created groups containing six to seven members. To maintain comparability, whenever we held in-class discussions or projects both classes met in their assigned groups.

Quizzes consisted of three to five open-ended questions. In both classes, once students had finished writing their answers, the instructor asked them to turn their papers over and remain seated until everyone had finished. In the control class, students turned in their papers and received an individual grade. In the experimental class, when all of the students had finished writing their individual answers, they joined their group. In an effort to discourage "free riders," whose quiz scores benefited from the preparation of other group members but who were not prepared to contribute themselves, we allowed only two minutes for group discussion. Although strategies sometimes shifted as group members became more familiar with the process, and with one another, students most often began by deciding which of the questions needed the most discussion (i.e., were the most difficult). They then shared answers to fill in gaps, debate inconsistent points, and/or worked to construct an answer original to the group. At the end of each two-minute period, the instructor informed the students that the allotted time had elapsed and they were to turn their papers over. The TA randomly selected one member of each group whose quiz score would count as the grade for the entire group. Each student in the experimental class received an individual grade on the quiz as well as the "group grade" earned by the randomly selected student. When the instructor returned the papers, students were able to compare what they had earned individually to the grade

earned by their group. In her written and verbal descriptions of the collaborative process, the instructor indicated that students should meet with her if they had problems with any individual group member's performance or concerns about communication between group members.

We did not inform the members of either class about the study until the last week of the semester. On the last day of class, the TA informed the students that she would like to use their course grades and the survey information concerning the quizzes for a research project that would fulfill one of the requirements of her Master's degree program in sociology. She then debriefed each class explaining that she was interested in understanding the effectiveness of pop quizzes and groups on student learning and other outcomes. She went on to explain that the university's Institutional Review Board for the Protection of Human Subjects had approved the study's methodology prior to our collecting any data. The TA then distributed an institutionally approved consent form describing the goals and procedures of the study. The form asked students for their written consent to use their course grades and survey answers as data to be analyzed for this study. In addition to this study being the basis of the teaching assistant's thesis, the authors agreed that she should be the one to ask for informed consent because she was in no way involved in determining final grades. The instructor did not take part in the formal debriefing process, did not distribute or collect the consent forms, and students were informed that the instructor would not know whether or not they decided to participate. As stated in the consent form, once the TA "entered the demographic information into the computer, [she] deleted [student names] from the file. As a result, there [is] no way that [students can be] personally identified with any of the information related to this study." The TA asked students whether they had any questions about the study or the consent form. All students in the control class ($n = 42$) and the experimental class ($n = 36$) agreed to participate and signed the consent form.

Data Collection Procedure and Analysis

Student characteristics. To compare the two classes with regard to demographic (e.g., gender, race, age) and other characteristics (e.g., GPA, ACT score, hours spent in paid employment, class standing), we analyzed data obtained from university records and from a demographic questionnaire distributed after we had received informed consent from each student. We used *t*-tests and chi-square statistics to compare the two groups. As the results presented in Table 1 indicate, the two classes did not differ significantly on any of these variables.

Survey data. Following the strategy employed by McKinney and Graham-Buxton (1993) and Helmericks (1993), we used self-administered surveys to obtain detailed information about students' perceptions of the quizzes (both classes) and the collaborative testing process (experimental class). Our procedures were somewhat different from those used previously, however, in that we gathered baseline data at the start of the semester in addition to the more standard evaluation information collected later. This enabled us to determine the extent to which students' views changed over time. We administered three anonymous written questionnaires during the course of the semester. Only on the demographic survey--distributed on the last day of class after students had provided informed consent--did the students include their names. Because the three earlier surveys did not include identifying information, we could not connect the data obtained from these surveys to the data obtained about individual student performance in the course.

Eighty-eight percent of the students in the control class and 86 percent in the experimental class completed the first written questionnaire. For the second survey, the response rate dropped to 55 percent for the students in the control class and 67 percent for the students in the experimental class. For the third and final survey 86 percent of

the students responded in the control class and 79 percent of the students responded in the experimental class.

Measures

Learning. As with most other studies of collaborative learning (e.g., Cortright et al. 2003; Helmericks 1993; McKinney and Graham-Buxton 1993), we operationalized learning using student grades: *quiz* grades, *exam* grades, and final *course* grades. Each of the eight quizzes administered was worth 10 points and each of the exams was worth 80 points. We determined the final course grade by summing the points earned from eight quizzes, three exams, an optional fourth exam, one paper, three sets of discussion questions, and extra credit. We then divided the total points earned by the total points possible and multiplied this score by 100. Students' final grades ranged from 27 to 108. We used *t*-tests to examine mean score differences and to test the three hypotheses related to learning.

Behavior. The second purpose of this study was to examine how this form of CLG affects student behavior, particularly students' preparation for class. *Class preparation* assessed the students' perceptions regarding the extent to which the unannounced quizzes motivated them to complete assigned readings prior to coming to class. On each of three surveys we asked students to indicate how helpful the "pop" quizzes would be (had been) in motivating them to keep up with the reading (1 = not at all helpful to 10 = very helpful). We used *t*-tests and chi-square statistics to test our hypothesis regarding the effect of collaborative testing on students' preparation for

Table 1. Demographic and Other Characteristics for Each Class and the University

	Control Class (*n*=42)		Experimental Class (*n*=36)			University
Variable	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	***p* value**	**Mean**
Age in years[a]	20.67	5.68	21.88	6.53	.408	25.00
Credits earned	26.70	28.36	26.73	20.81	.996	N/A
ACT score [a,b]	20.37	4.42	21.22	4.56	.497	20.00
University GPA[a]	2.65	.80	2.58	.90	.746	2.82
High School GPA[a]	2.99	.71	2.72	.69	.140	2.83
Work hours	17.57	13.24	17.35	15.30	.950	N/A
Percent employed	72.2%		67.6%		.676	N/A
Percent female[a]	66.7%		58.3%		.448	53.0%
Percent racial/ethnic minorities[a]	25.0%		11.8%		.059	20.0%
Percent first-year	65.9%		52.9%		.256	N/A
Percent living off-campus	80.6%		67.6%		.313	N/A

Note: Significant differences between the experimental and control group means based on two-tailed *t*-tests. Significant differences for all percentages based on chi-square tests.
[a] For the university, data are for first-year students entering in the fall of 2002.
[b] Possible range of ACT scores = 1 - 36.

class.

Attitudes. Given that prior research on CLGs indicates that they positively affect a range of student attitudes (Cooper and Mueck 1990), we operationalized this concept in several ways. *Grade attitudes* assessed students' views about the effect they expected the quiz process to have on their learning in terms of their final grade. Thus, we asked students to indicate how they felt the pop quizzes would affect their final grade in the class (1 = very negatively to 10 = very positively).

Research on CLGs has further indicated that they have a positive influence on students' attitudes about the class (Kulik and Kulik 1979). We assessed course-related attitudes in a number of ways. We used a question from the standardized course evaluation to measure the variable a*ttitudes about sociology,* asking students to indicate their view of the following statement: "As a result of taking this course, I have more positive feelings toward this field of study" (1=definitely false to 5=definitely true). We measured *positive comments about quizzes* using responses to an open-ended question concerning students' feelings about the quizzes. We coded a response 1 if the statement could be classified as "positive." If the statement was "negative" or the student indicated he or she "didn't know," we coded the response as a 0. A typical positive response was, "Right now I think that pop quizzes are [a] good idea, because it [sic] could keep up our motivation with the reading." Examples of typical negative and "don't know" responses are, "Right now I am very nervous about them because, although I do the reading, I am afraid that the quiz will require recall that I do not have regarding the material. I feel that announced quizzes may be as effective as unannounced quizzes" and "Not sure." (Complete response information available upon request.) Finally, *attitude change* assessed the change over time in student attitudes about the quizzes. On the second and third surveys, we asked students to indicate how much their attitudes had changed regarding the quiz process (1 = much less positive to 10 = much more positive).

RESULTS

Does Collaborative Testing Improve Students' Learning?

We hypothesized that participating in collaborative testing would improve student learning as measured by quiz grades, exam grades, and final course grades. Table 2 presents the results of the *t*-tests used to examine these hypotheses. The findings presented in Table 2 indicate support for the quiz hypothesis in that students in the experimental class scored significantly higher on each quiz than did those in the control class. However, these positive effects did not extend to either the exam grades or the final grades. The results in Table 2 show no significant difference in the mean scores earned by students in the experimental class as compared to the control class. Thus, we found no support for our hypotheses that participation in CLGs would result in higher exam scores and final grades.

Does Collaborative Testing Improve Students' Class Preparation?

We also hypothesized that students in the experimental class would be more likely to report that the quizzes were helpful in motivating them to keep up with the reading than would students in the control class. As Table 3 shows, we found support for this hypothesis. Students in the experimental class were more likely to indicate that the quiz process encouraged them to complete the assigned reading as compared to the results for the control class. We found this significant difference across all three of the surveys that we administered.

Does Collaborative Testing Improve Students' Attitudes?

Our third set of hypotheses stated that students in the experimental class would express more positive attitudes than those in the control class. The results presented in Table 3 indicate that even though the group

quiz process did not significantly affect the students' final grades, the students in the experimental class felt more positive about how the quizzes were likely to affect their final grades than did those in the control class. This finding supports our hypothesis regarding students' attitudes toward their grades. Students in the experimental class also held more positive attitudes about sociology than those in the control class, offering support for another of our hypotheses.

To test our hypothesis that the experimental group would express more positive attitudes than the control group about the use of "pop" quizzes, we examined the positive responses to an open-ended question that asked students to explain how they felt about the unannounced quizzes used in the class. The responses ranged from simple comments such as, "great," "works well," to comments that included why the students felt the quizzes were positive: "I do not think they were bad. They actually helped especially when you were not sure of the answers," and "I feel as though they're helpful for points."

After coding the responses, we used chi square tests to test this hypothesis. The results shown in Table 3 support the hypothesis given that students in the experimental class felt more positive about the quiz process than those in the control class. The experimental class reported feeling more positive about the quiz process than the control class on each of the three surveys we administered during the semester.

Finally, we were interested in exploring the extent to which the two classes might have changed their attitude about the quizzes over time. When students initially hear that part of their grade will be based on "group effort," many are skeptical of the process and perceive it to be unfair. To investigate whether students changed their views once they had more experience with the process we examined student responses

Table 2. Means and Standard Deviations for Each Class and Form of Evaluation

	Control Class (*n*=42)		Experimental Class (*n*=36)		
Form of Evaluation	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	***p* value**
Quizzes					
Quiz 1	6.00	2.39	8.75	1.66	.000
Quiz 2	4.60	2.59	6.31	2.35	.005
Quiz 3	5.72	3.09	9.07	1.22	.000
Quiz 4	6.20	2.58	7.67	1.90	.019
Quiz 5	5.87	2.75	7.41	1.95	.026
Quiz 6	7.31	2.12	8.95	1.30	.001
Quiz 7	6.70	2.90	8.26	1.50	.014
Quiz 8	7.27	2.08	8.33	1.20	.018
Exams[a]					
Exam 1	51.26	16.86	56.90	13.32	.109
Exam 2	59.68	13.84	60.04	11.28	.900
Exam 3	57.78	13.85	56.43	11.59	.654
Course[a]					
Final Grades	65.52	20.08	73.74	19.35	.071

Note: Significant differences between group means based on two-tailed *t*-tests.
[a]One-tailed t-tests for Exam grades did not indicate a significant difference (Exam 1, $p = .054$; Exam 2, $p = .450$; Exam 3, $p = .327$). One-tailed t-tests for Final Grades indicated a significant difference (Final Grades, $p = .035$).

to a question on the second and third surveys that asked students how much their attitudes had changed regarding the quiz process. As indicated in Table 3, the attitudes toward pop quizzes improved for both classes on each survey. However, our *t*-tests indicate students who participated in collaborative testing reported that their attitudes had become increasingly positive over the course of the semester compared to the responses of the students in the control class.

DISCUSSION AND CONCLUSIONS

Scholars of teaching and learning have made a number of advancements in our understanding of how CLGs affect student outcomes, especially regarding student learning. Despite this growth in understanding, researchers know relatively little about how CLGs affect student behavior and attitudes or the extent to which their utility might extend to testing. This study attempted to fill these gaps by examining the effects of collaborative testing on learning, behavior, and attitudes among college students enrolled in an Introduction to Sociology course. Our findings suggest that collaborative testing is beneficial in a number of ways.

Students participating in collaborative testing had higher quiz grades than students who did not. The peer interaction that occurred in the experimental class may be one reason that students were able to earn

Table 3. Comparison of Course-Related Behavior and Attitudes for Each Class

	Control Class (*n*=42)		Experimental Class (*n*=36)		
Behavior or Attitude	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	***p* value**
Class Preparation					
Survey 1	7.19	2.63	8.76	1.60	.000
Survey 2	5.52	2.64	8.62	1.50	.000
Survey 3	5.83	2.87	8.58	1.56	.000
Grade Attitudes					
Survey 1	5.88	2.25	7.13	1.89	.001
Survey 2	4.65	2.71	6.86	2.48	.003
Survey 3	4.42	2.97	6.24	2.76	.010
Attitudes about Sociology	2.65	1.60	3.75	1.30	.005
Percent Positive Comments about Quizzes					
Survey 1	58.14%		86.84%		.008
Survey 2	50.00%		96.42%		.000
Survey 3	52.78%		91.18%		.000
Pop Quiz Attitude Change					
Survey 2	4.61	1.80	7.07	1.98	.000
Survey 3	4.25	2.38	6.64	2.56	.000

Note: Significant differences between group means based on two-tailed *t*-tests. Differences for percentages of positive comments based on chi-square tests.
[a]Percentage of open-ended responses coded as "positive."

higher grades. Nonetheless, these positive effects did not lead to higher exam scores or final grades among the students in the experimental class.

The literature clearly shows that CLGs have a positive impact on student learning. There are several explanations for why the effect of the collaborative quizzes did not generalize. First, the quiz grades constituted a small percentage (14%) of the students' final grade. The students' final grades in this course were based on their performance on the eight quizzes, three required exams, one optional exam, discussion questions, and a paper. In other research using CLGs, instructors used the process for projects, papers, or presentations that were worth a greater percentage of the final grade than the quizzes used in this study. The use of collaborative testing with exams, as opposed to quizzes, may result in improved learning outcomes. For example, Cortright et al. (2003) found more general positive learning outcomes when CLGs were applied to examinations—the only evaluation method used.

A second explanation for the mixed findings on learning may be that students did not work as effectively in their groups as they might have. Johnson et al. (1991) suggest that instructors should explicitly explain to students the social skills needed for effective CLGs and should provide opportunities for students to participate in evaluative "group processing." We included neither of these basic elements in this study. Students might have benefited from a discussion early in the semester about the social skills needed to conduct effective group discussions. Setting aside time for evaluating the group process also might have enabled students to praise those who were contributing and to encourage those who were not to become more involved. Researchers interested in using the collaborative testing process may want to consider adding these elements.

Students in the experimental class were more likely than those in the control class to report that the quizzes were helpful in motivating them to keep up with the reading. This result indicates that collaborative testing may be a useful tool for instructors who are seeking new ways to encourage their students to come to class prepared. Students' open-ended responses suggest that there was one primary reason for this finding: students in the experimental class felt a sense of *interdependence* or responsibility for their peers. Johnson et al. (1991) and Slavin (1983) suggest that CLGs create a situation in which students feel accountable to and for their peers. An individual student's performance affects not only the student's grade but also the grades of the others in his or her group. Students in the experimental class responded to open-ended survey questions with statements that reflected their feelings of responsibility to other students. For example, a student in the experimental class commented on the last survey, "[It] has made me want to work harder to get a better grade for everyone." Another student remarked, "I have been forced to keep up with the readings so I don't hurt the others in my group with poor grades." These comments reflect the view that, in the experimental class, students recognized that they were interdependent, one of the five basic CLG elements identified by Johnson et al. (1991) and a critical facet of the sociological imagination.

Our use of collaborative testing also had positive effects on students' attitudes. These results corroborate the findings of other researchers regarding the positive impact of CLGs on attitudes (Campbell and Smith 1997; Helmericks 1993; McKinney and Graham-Buxton 1993). Regardless of the actual effect on course grades, students who participated in collaborative testing felt more positive about the effect that the quizzes were likely to have on their final grade than those who worked alone. Several students' comments in the experimental class reflected this attitude: "I do not like them but at the same time it does help the overall grade," "I think that they help you to read and learn more about the readings" and "for the most part I think they are helping my

grade."

At the end of the semester, students in the experimental class also felt more positive about the discipline of sociology than those in the control class. This finding supports other research that suggests that CLGs positively influence students' attitudes toward the field of study about which they are learning (Kulik and Kulik 1979). This may be the result of students' beliefs that they were better able to learn the material as a result of the collaborative learning process. It is possible, however, that the students in the experimental class may have simply been expressing their more positive attitude toward the class in general or toward the opportunity to participate in the group quiz process.

Not only were students in the experimental class more likely to express positive attitudes about the quiz process than those in the control class, but these attitudes also became more positive over time. These findings may have resulted from the students in the experimental class feeling positive about working in a group. On each survey, more students in the experimental class responded with positive comments regarding having to rely on their group members. Compared to those from the control class, the comments from the experimental class were significantly more positive between the first and the second survey and between the second and the third survey. Some examples of these types of comments are: "Group grading is the positive aspect of the quizzes. It helps if you cannot think of something to figure it out and see others perspectives" and "It incourages [sic] better students to help others to understand concepts and motivated me to do more to help the group get a good grade." These comments indicate that *after* experiencing the group-grading process, the attitudes of students in the experimental class became more positive.

Although they are merely suggestive, the positive peer interactions reflected in the comments from the experimental class indicate that CLGs may have implications for student retention (Campbell and Smith 1997; Tinto 1994). Future studies on collaborative learning should include an analysis of the impact that collaborative testing may have on retaining at-risk students. At-risk students may be students from lower socio-economic statuses and are often first generation college students or racial minorities (Tinto 1994). These students may be less likely to complete their university education. For example, at the university where we conducted this study, the retention rates for racial minorities are lower than for those of their white counterparts. Fifty-seven percent of racial minority first-year students at this university returned to school the following semester during the 2001-2002 academic year compared to 68 percent of white students (Gaylord 2003). If collaborative testing motivates students to complete assignments and to develop positive attitudes about both their peers and the course material, it may also help to foster student retention.

Finally, several unexpected issues surfaced while we conducted this research on collaborative testing. Although we did not assign the groups until after the second week of the semester, waiting one more week might have led to more equitable attendance and participation rates across the groups. In addition, at the end of the semester, the groups had between four and six members. Millis and Cottell (1998) recommend that CLGs have between two and four members in order to encourage face-to-face interaction among all group members. Later assignment of groups and the creation of smaller groups might have allowed students more opportunities for enhanced communication. Instructors may want to consider the institution's attrition patterns when deciding the timing of group assignment. The potential effect of collaborative testing on college student attendance is one topic that we did not address in this study. We did not record attendance; therefore, we could not test the impact that this process had on attendance. If students who participate in collaborative learning are more likely to develop positive

attitudes about the class, they may be more likely to attend class. Studying the impact of collaborative testing on attendance may be critical for the development of further understanding on how group processes affect students' attitudes, behavior, and learning.

To conclude, previous researchers have found that collaborative learning groups have been associated with positive student outcomes. Our study supports and extends these results by showing that the collaborative process can be usefully applied to in-class quizzes. Students involved in the collaborative testing process developed positive attitudes about their learning, the quiz process, and the discipline of sociology. Students also reported improved study habits. These results provide further empirical support to those instructors and researchers who have championed the use of collaborative learning strategies and should suggest to others that they might be well worth considering.

REFERENCES

Astin, Alexander. 1993. *What Matters in College: Four Critical Years Revisited*. San Francisco, CA: Jossey-Bass.

Bouton, Clark C. and Russell Y. Garth. 1983. *Learning in Groups*. San Francisco: Jossey-Bass.

Campbell, William E. and Karl A. Smith. 1997. *New Paradigms for College Teaching*. Edina, MN: Interaction Book Company.

Cohen, Elizabeth G. 1994. "Restructuring the Classroom: Conditions for Productive Small Groups." *Review of Educational Research* 64:1-35.

Cooper, Jim and Randall Mueck. 1990. "Student Involvement in Learning: Cooperative Learning and College Instruction." *Journal on Excellence in College Teaching* 1:68-74.

Cortright, Ronald N., Heidi L. Collins, David W. Rodenbaugh, and Stephen E. DiCarlo. 2003. "Student Retention of Course Content is Improved by Collaborative-Group Testing." *Advanced Physiological Education* 27:102-8.

Dougherty R.C., C.W. Bowen, T.G. Berger, W. Rees, E.K. Mellon, and E. Pulliam. 1995. "Cooperative Learning and Enhanced Communication." *Journal of Chemical Education* 72:793-7.

Gaylord, Thomas. 2003. *The University of Akron Fact Book*. Akron, OH: The University of Akron.

Hansell, Stephen and Robert E. Slavin. 1981. "Cooperative Learning and the Structure of Interracial Friendships." *Sociology of Education* 54:98-106.

Helmericks, Steven G. 1993. "Collaborative Testing in Social Statistics: Toward Gemeinstat." *Teaching Sociology* 21:287-97.

Hoffman, Elizabeth. 2001. "Successful Application of Active Learning Techniques to Introductory Microbiology." *Microbiology Education* 2:5-11.

Johnson, David W. and Roger T. Johnson. 1990. "Cooperative Learning and Achievement." Pp. 23-38 in *Cooperative Learning: Theory and Research*, edited by Shlomo Sharan. New York: Praeger.

_____. 1994. "Learning Together." Pp. 51-65 in *Handbook of Cooperative Learning Methods*, edited by Shlomo Sharan. Westport, CT: Greenwood.

Johnson, David W., Roger T. Johnson, and Karl A. Smith. 1991. *Cooperative Learning: Increasing College Faculty Instructional Productivity*. Washington DC: George Washington University.

Johnson, David W., Geoffrey Maruyama, Roger T. Johnson, Debra Nelson, and Linda Skon. 1981. "Effects of Cooperative, Competitive, and Individualistic Goal Structure on Achievement: A Meta-Analysis." *Psychological Bulletin* 89:47-62.

Kulik, James A. and Chen-Lin C. Kulik. 1979. "College Teaching." Pp. 70-96 in *Research on Teaching: Concepts, Findings, and Implications*, edited by Penelope L. Peterson and Herbert J. Walberg. Berkeley, CA: McCutcheon.

Longmore, Monica A., Dana Dunn, and Glen R. Jarboe. 1996. "Learning by Doing: Group Projects in Research Methods Classes." *Teaching Sociology* 24:84-91.

McIntyre, Lisa J. 2002. *The Practical Skeptic: Core Concepts in Sociology*. Boston, MA: McGraw Hill.

McKinney, Kathleen and Mary Graham-Buxton. 1993. "The Use of Collaborative Learning Groups in the Large Class: Is It Possible?" *Teaching Sociology* 21:403-8.

Millis, Barbara J. and Phillip G. Cottell Jr. 1998. *Cooperative Learning for Higher Education Faculty*. Phoenix, AZ: The Oryx Press.

Rao, Sumangala P., Heidi L. Collins, and Stephen E. DiCarlo. 2002. "Collaborative

Testing Enhances Student Learning." *Advances in Physiology Education* 26:37-41.

Rau, William and Barbara S. Heyl. 1990. "Humanizing the College Classroom: Collaborative Learning and Social Organization among Students." *Teaching Sociology* 18:141-55.

Rinehart, Jane A. 1999. "Turning Theory into Theorizing: Collaborative Learning in a Sociological Theory Course." *Teaching Sociology* 27:216-32.

Schwalbe, Michael. 2001. *The Sociologically Examined Life*. Mountain View, CA: Mayfield.

Sernau, Scott. 1995. "Using a Collaborative Problem-Solving Approach in Teaching Social Stratification." *Teaching Sociology* 23:364-76.

Sharan, Shlomo. 1980. "Cooperative Learning in Small Groups: Recent Methods and Effects on Achievement, Attitudes, and Ethnic Relations." *Review of Educational Research* 50:241-71.

Slavin, Robert E. 1983. *Cooperative Learning*. New York: Longman.

_____. 1990. *Cooperative Learning: Theory, Research, and Practice*. Englewood Cliffs, NJ: Prentice Hall.

Slavin, Robert E. and Eileen Oickle. 1981. "Effects of Cooperative Learning Teams on Student Achievement and Race Relations." *Sociology of Education* 54:174-80.

Slavin, Robert E., Shlomo Sharan, Spencer Kagan, Rachel Hertz Lazarowitz, Clark Webb, and Richard Schmuck. 1985. *Learning to Cooperate, Cooperating to Learn*. New York: Plenum.

Tinto, Vincent. 1994. *Leaving College: Rethinking the Causes and Cures of Student Attrition*. 2d ed. Chicago, IL: University of Chicago Press.

Treisman, Philip. 1985. "A Study of the Mathematics Performance of Black Students at the University of California, Berkeley." Ph. D. dissertation, Department of Education, University of California, Berkeley, CA.

Weitz, Rose. 1995. "A Group Technique for Testing Knowledge about HIV/AIDS." *Teaching Sociology* 23:44-7.

Zapalska, Alina and Geoff Perry. 2002. "Collaborative Learning Instrument in Teaching Entrepreneurship Issues." *Journal of Teaching in International Business* 13:57-76.

Suzanne R. Slusser is a doctoral candidate in the Department of Sociology at The University of Akron. Her research interests include gender and international development.

Rebecca J. Erickson is associate professor of sociology at The University of Akron. Her research interests include the sociology of emotion, work and family, and self and identity. Her current project assesses the effects of occupational structure, culture, and emotional labor on nursing burnout and turnover.