Cooperative Learning Effects on Teamwork Attitudes in Clinical Laboratory Science Students

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OBJECTIVE: To evaluate clinical laboratory science (CLS) student attitudes toward teamwork when using cooperative learning (CL) as compared to individual learning (IL) in a course and to determine if learning method affects student attitudes toward the course itself.

DESIGN/SETTING/PARTICIPANTS: This was a multi-institutional study involving eight classrooms in seven states. The effects of CL and IL on student attitudes were compared for 216 student participants.

INTERVENTION: One group of students learned the course material through a CL approach while a second group of students learned via a traditional IL approach. For each course, the instructor, class material, and examination content was identical for the CL and IL students; the only variable was learning method.

MAIN OUTCOME MEASURE: Student attitudes toward teamwork and toward the course were evaluated with a 35-item Attitude Questionnaire administered as a posttest. Mean scores for the CL and IL groups were compared using the Student t-test for independent samples.

RESULTS: No significant difference was seen between the CL and IL students when assessing the first 30 questions on student attitudes toward teamwork (means = 98.42 and 98.22, respectively) when all institutions were combined. Comparable results were seen for each of the eight institutions. For the five questions comparing attitudes toward the course itself, there usually was no significant difference in attitude between CL and IL students. The only classrooms where CL students had more positive attitudes were those with instructors who had more than 10 years experience with CL.

CONCLUSION: Results suggest that CL produces similar student attitudes toward teamwork and toward a CLS course as does IL.

ABBREVIATIONS: CL = cooperative learning; CLS = clinical laboratory science; IL = individual learning; STAD = student-teams achievement divisions.

INDEX TERMS: active learning; cooperative learning; instructional methods; teaching strategies.

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Healthcare institutions are increasingly encouraging interdisciplinary communications among health professionals to optimize patient care. Laboratorians are essential to patient outcome teams; however, they lack a strong background in communication and teamwork skills.[1] Within the laboratory itself, managers have instituted self-directed work teams as one response to the demand by hospital administrators to increase laboratory productivity.[2]

Employers now expect clinical laboratory science (CLS) graduates to possess teamwork skills at the time of career-entry.[3] Several surveys have found that the ability to function effectively within a team ranks high among the competency areas required for laboratory careers.[4-7] The current Standards of Accredited Educational Programs for the Clinical Laboratory Scientist/Medical Technologist state that the curriculum must include "principles of interpersonal and interdisciplinary communication and team-building skills".[8]

Preparation for teamwork may be lacking in CLS educational programs. In a study of 410 healthcare professionals from eight allied health disciplines, participants were surveyed to determine their attitudes toward, and preparedness for, interdisciplinary teams.[9] Medical technologists reported the least experience with teamwork in their undergraduate education of any of the eight health professions, and they were the least supportive of teamwork in general.

Because of the already tightly-packed CLS curriculum, educators are encouraged to incorporate teamwork and communication skill-building within existing courses.[6] In a recent study, 69% of 83 medical laboratory educators reported that they incorporate some type of group activity in their courses.[7] However, some of these activities are only one-time group presentations.

It has been proposed that using cooperative learning (CL) within the classroom is an important vehicle for teaching teamwork skills to laboratorians.[10,11] CL is one form of collaborative learning "in which students of all performance levels work together in small groups toward a group goal".[12] Most empirical studies of CL have been performed at the elementary and secondary education level. These studies have provided strong support for the use of CL to improve interpersonal and intergroup relationships.[13] An increasing number of CL reports from institutions of higher learning provide anecdotal evidence that the same may be true for the college-aged population.

Proponents of using CL in CLS education cite enhanced ability to work within a team as one benefit of this methodology. However, the effectiveness of this learning strategy in undergraduate CLS education is poorly understood, and there is little empirical data to support these claimed benefits. A recent study used a teamwork assessment tool to evaluate CLS student skills and knowledge about teamwork in both CL and lecture courses.[14] The authors found no statistical differences between pre and posttest scores for either the CL or lecture groups. Limitations in this study include a small number of participants (N = 22), short timeframe (4-week course of study), and the use of different instructors for the CL and traditional lecture classes.

The purpose of this study was to evaluate CLS student attitudes toward teamwork when a CL strategy was used in a CLS course taught in a university or college setting. These attitudes were compared to those of students who took the same courses using a traditional individual learning (IL) strategy. It was assumed that a student's attitudes toward teamwork indicate his/her propensity toward teamwork in the workplace. The study also examined whether the learning method, CL or IL, would affect student attitudes toward the course itself. This was a multi-institutional study, and at each participating institution the same instructor taught both the CL and IL classes.

MATERIALS AND METHODS

Subjects

The population for this study consisted of baccalaureate level CLS students at colleges and universities in the United States. A letter inviting a faculty member to participate in this study was mailed to each of the National Accrediting Agency for Clinical Laboratory Science approved colleges and universi-

ties offering a CLS major. The faculty member was asked to teach one year's class using a CL approach and teach another year's class of the same course using a traditional IL strategy. Both classes had to be taught by the same instructor and use the same textbook(s), handouts, and other supportive materials. The number and content of the quizzes and exams also had to be identical. In other words, both classes were to be treated in the same way with the only variable being the instructional strategy employed.

Cooperative learning design

There are many CL methods described in the literature. The CL model used in this study is based upon the Student-Teams Achievement Divisions (STAD) format as defined by Slavin.[13] When assigning students to groups, instructors were asked to maximize heterogeneity within each group in regard to academic ability, gender, and ethnic background and to place three or four students per group. Groups remained together throughout the semester. At least 50% of class time was devoted to CL activities. Specific instructions regarding the CL protocol were provided to participating instructors, and each instructor was provided with a copy of a textbook on CL.[15]

During the first week of class, CL groups were given a verbal description of the instructional format being used. Groups were asked to complete the The Winter Survival Exercise.[16] Using an icebreaker such as this during the first class session provides a non-threatening opportunity for group members to get to know each other and practice group decision-making.

Members of each group were encouraged to study together, both inside and outside of structured class time. Group members were asked to exchange class schedules and telephone numbers, to the extent that they were comfortable doing so. Instructors monitored the groups and served as resources, but were not to become group leaders or mediators. Students worked together to learn the material, but each student was held individually accountable to complete assignments and tests. Test grading was based upon the STAD schema where bonus points could be earned depending upon the improvement scores of group members.[13] This encouraged both group responsibility and individual accountability.

Individual learning design

Students worked as individuals in class, and the instructors did not encourage interaction. Students were advised to direct questions to the instructor, not other students. All assignments and tests were completed and graded individually.

Teamwork attitude questionnaire

A search of the literature failed to reveal any established instruments for evaluating a student's attitudes toward teamwork. For purposes of this study, the researcher adapted items from two questionnaires to design a 30-item attitude questionnaire (Figure 1).[17,18] Student responses were recorded along a Likert scale. In addition to the 30-item attitude questionnaire, five statements were included that assessed student attitude toward the course itself. Students were asked to designate along a Likert scale the extent of their agreement with statements such as, "The learning format used in this course helped me do my best in this subject." These statements were derived from reports in the CL literature that cited these attitudes as benefits of CL.

Administration of attitude questionnaire

At the beginning of the semester, students were asked to complete informed consent forms and demographic data sheets (including gender, ethnicity, and year in school). Attitude questionnaires were administered during the last week of class; all tallying of questionnaire responses was performed by the researcher. The questionnaire was used only as a post-test because using it as a pretest could sensitize the students to the problem being studied and make them susceptible to persuasion regarding their attitudes toward CL. While a change in attitude for members of each group might be a useful observation, a pretest could provide unacceptable interference and be a threat to external validity.[19]

The first 30 questions of the attitude questionnaire were graded together and assigned a total numerical score. Questions #31-35 scores were analyzed individually. Mean scores for the CL and IL groups were analyzed using the Student t-test for independent samples, preceded by Hartley's F test for homogeneity of variance. An alpha level of 0.05 was used when evaluating significance in all of these tests.

RESULTS

Ten faculty members agreed to participate in the study. However, during the course of the study, two participating faculty members withdrew. Therefore, data from eight faculty members could be analyzed. Two of these faculty members were from the same institution, but they taught different students and different subjects. The CL strategy was used during the first year of the study by three participants, while the IL strategy was used the first year by the other five faculty members.
Seven states (Colorado, Delaware, Kentucky, Louisiana, Mississippi, North Carolina, and Wisconsin) were represented in the study. The CLS courses under study included bacteriol-

Figure 1. Attitude questionnaire

Use the following key when responding to the statements:
1 = strongly disagree; 2 = somewhat disagree; 3 = neutral/ no opinion; 4 = somewhat agree; 5 = strongly agree

	Circle your response				
	strongly disagree				strongly agree
1. I prefer working by myself in class.	1	2	3	4	5
2. We should be required to do more small group projects in class.	1	2	3	4	5
3. Working within small groups in class makes learning easier.	1	2	3	4	5
4. Lecture is a better use of class time than are small study groups.	1	2	3	4	5
5. Other class members can be valuable resources in my learning.	1	2	3	4	5
6. I like to help other students learn.	1	2	3	4	5
7. I prefer individual competition over cooperation in the college classroom.	1	2	3	4	5
8. I can do better in a class that has organized study groups.	1	2	3	4	5
9. Competing with others is a good incentive for me.	1	2	3	4	5
10. I get more out of my classwork when I work by myself.	1	2	3	4	5
11. We should be required to do less small group work in class.	1	2	3	4	5
12. Small study groups are a valuable classroom strategy to aid learning.	1	2	3	4	5
13. I like knowing if I had one of the top grades in class.	1	2	3	4	5
14. Several people working together generally make better decisions than any one person alone can make.	1	2	3	4	5
15. I learn most effectively when I work on my own.	1	2	3	4	5
16. It is more enjoyable to work on class assignments with an organized study group.	1	2	3	4	5
17. Teachers helping students work effectively in small groups takes too much of teachers' valuable time.	1	2	3	4	5
18. I learn most effectively when I am part of a small group.	1	2	3	4	5
19. Most people make better decisions alone than could be made by a group.	1	2	3	4	5
20. The input of other people often slows down other members of a group and makes decision-making more difficult.	1	2	3	4	5
21. I like to share my ideas and materials with other students.	1	2	3	4	5
22. I can learn important things from other students.	1	2	3	4	5
23. I prefer working within small groups in class.	1	2	3	4	5
24. I like to compete with other students to find out who does the best work.	1	2	3	4	5
25. I am happiest when I am competing with other students	1	2	3	4	5
26. I would prefer someday to work for an organization that uses a team-based management style.	1	2	3	4	5
27. Rewards (pay/grades) should be based on individual, rather than group, work.	1	2	3	4	5
28. Companies that use management teams probably produce a higher quality product.	1	2	3	4	5
29. Employees who are part of a work team are probably happier than those who work individually.	1	2	3	4	5
30. The American style of business which rewards individual effort is better than the Japanese style which rewards group efforts.	1	2	3	4	5
31. The learning format used in this course helped me do my best in this subject.	1	2	3	4	5
32. I have a positive attitude toward this subject as a result of this course.	1	2	3	4	5
33. I enjoyed this course.	1	2	3	4	5
34. I am satisfied with my performance in this course.	1	2	3	4	5
35. This course gave me a better understanding of how to work well with others.	1	2	3	4	5

ogy, chemistry, concepts in laboratory medicine, hematology (at two institutions), immunology, immunohematology, and microbiology. Sixty-three males and 153 females participated in the study for a total of 216 students. Out of this total, 44 were minority students. All levels of undergraduate students were represented from first year through fifth year.

Out of 216 participating students, 212 responded to all of the first 30 questions. These questions explored student attitude toward teamwork in the workplace and in classroom settings in general so they were analyzed together. Each question had five possible responses on a Likert scale. A total of 30 points on Questions #1-30 indicated the most extreme individual attitude, a score of 150 points indicated the most extreme cooperative attitude, and a score of 90 points indicated a neutral attitude. The lowest total point score that any student had was 44, and the highest was 143.

The means of the CL students were compared to those of the IL students using the Student t-test preceded by Hartley's F test. Means for all 212 responding students were analyzed as a group and then by institution (Table 1). The CL students and the IL students demonstrated similar attitudes toward Questions #1-30. When all institutions were combined, the CL students had a mean score of 98.42 while the IL students had a mean of 98.22. Comparable results were seen for each institution. None of the differences in scores between CL and IL students was significant.

Questions #31-35 on the attitude questionnaire asked students to respond along a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree) about attitudes toward the courses they had just completed. Out of 216 participating students, 213 responded to all five questions. Each question was analyzed separately. First, a comparison was made between CL and IL students with all students combined, and then comparisons were made for each institution.

Question #31 states, "The learning format used in this course helped me do my best in this subject." When all 213 students were analyzed as a group, the IL group mean of 3.42 did not differ significantly from the CL group mean of 3.28 (Table 2). There also was no significant difference between the means of the different learning groups for six of the eight individual institutions. However, for institution #1 the IL group had a significantly higher mean (4.58) than did the CL group (3.90). And, for institution #3 the CL group had a significantly higher mean (3.82) than did the IL group (3.00). Thus, the students who agreed more strongly that the learning format helped them do their best were in the IL group at institution #1 and in the CL group at institution #3.

Question #32 on the attitude questionnaire reads, "I have a positive attitude toward this subject as a result of this course." When all 213 students were analyzed together, the IL group mean of 3.82 did not differ significantly from the CL group mean of 3.63 (Table 3). There was no significant difference between the means of the different learning groups for six

Table 1. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for attitude toward teamwork questions #1-30 on the attitude questionnaire

	All students	Institution number							
	n = 212	1	2	3	4	5	6	7	8
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	106	10	16	16	15	10	19	11	9
IL Method mean	98.22	108.50	99.00	102.95	94.83	90.00	91.67	96.11	105.00
CL Method mean	98.42	101.40	99.50	101.38	98.13	103.80	89.53	104.00	94.33
Critical t value @ p = 0.05	1.97	2.08	2.05	2.03	2.05	2.11	2.03	2.10	2.18
t-test value	0.10 NS*	1.16 NS	0.10 NS	0.31 NS	0.73 NS	1.48 NS	0.50 NS	1.28 NS	1.52 NS

* NS = Not significant

of the eight individual institutions. However, the IL group at institution #8 had a stronger positive attitude toward the subject (mean = 4.20) than did the CL group (mean = 2.78). And, for institution #3 the CL group had a significantly stronger positive attitude toward the subject (mean = 4.41) than did the IL group (mean = 3.86).

Question #33 states, "I enjoyed this course." When all 213 students were analyzed together, the IL group mean of 3.96 did not differ significantly from the CL group mean of 3.77 (Table 4). There also was no significant difference between the means of the different learning groups for five of the eight individual institutions. However, for institutions #6 and #8 the IL groups had significantly higher means (3.44 and 4.40) than did the respective CL groups (2.68 and 2.89). And, for institution #5, the CL group had a significantly higher mean (4.30) than did the IL group (3.22). Therefore, the students who agreed more strongly that they enjoyed the course were in the IL group at institutions #6 and #8, and were in the CL group at institution #5.

Table 2. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for agreement with the statement, "The learning format used in this course helped me do my best in this subject."

	All students	**Institution number**						
	n = 213	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	107	10	16	17	15	10	19	11	9
IL Method mean	3.42	4.58	3.31	3.00	3.83	3.22	2.78	3.78	3.20
CL Method mean	3.28	3.90	3.06	3.82	4.00	3.70	2.42	3.18	2.22
Critical t value @ p = 0.05	1.97	2.08	2.06	2.03	2.04	2.11	2.03	2.10	2.18
t-test value	0.96 NS*	2.55 S†	0.97 NS	2.64 S	0.65 NS	1.02 NS	1.14 NS	1.55 NS	1.73 NS

* NS = Not significant
† S = Significant

Table 3. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for agreement with the statement, "I have a positive attitude toward this subject as a result of this course."

	All students	**Institution number**						
	n = 213	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	107	10	16	17	15	10	19	11	9
IL Method mean	3.82	4.58	3.54	3.86	4.11	3.22	3.22	4.11	4.20
CL Method mean	3.63	4.20	3.38	4.41	4.27	4.10	2.74	3.18	2.78
Critical t value @ p = 0.05	1.97	2.08	2.05	2.03	2.06	2.18	2.03	2.10	2.18
t-test value	1.41 NS*	1.57 NS	0.52 NS	2.27 S†	0.58 NS	1.69 NS	1.83 NS	1.77 NS	2.51 S

* NS = Not significant
† S = Significant

Question #34 on the attitude questionnaire is, "I am satisfied with my performance in this course." Results for the different learning groups are found in Table 5. When all 213 students were analyzed together, the IL group mean of 3.35 did not differ significantly from the CL group mean of 3.36. There also was no significant difference between the means of the different learning groups for seven of the eight individual institutions. However, for institution #7 the IL group had a significantly higher mean (4.11) than did the CL group (3.09), meaning that institution #7 IL students were more satisfied with their performance than were the CL students.

For question #35, "This course gave me a better understanding of how to work well with others," the IL group mean of 3.08 did not differ significantly from the CL group mean of 3.34 (Table 6). There also was no significant difference between the means of the different learning groups for six of the eight individual institutions. However, for institutions #3 and #5 the CL groups had significantly higher means (3.53

Table 4. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for agreement with the statement, "I enjoyed this course."

	All students	Institution number							
	n = 213	1	2	3	4	5	6	7	8
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	107	10	16	17	15	10	19	11	9
IL Method mean	3.96	4.67	3.46	4.23	4.17	3.22	3.44	4.22	4.40
CL Method mean	3.77	4.50	3.44	4.35	4.47	4.30	2.68	3.82	2.89
Critical t value @ p = 0.05	1.97	2.08	2.05	2.03	2.05	2.18	2.03	2.10	2.20
t-test value	1.42 NS*	0.76 NS	0.07 NS	0.53 NS	1.12 NS	2.23 S†	2.76 S	0.98 NS	2.92 S

* NS = Not significant
† S = Significant

Table 5. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for agreement with the statement, "I am satisfied with my performance in this course."

	All students	Institution number							
	n = 213	1	2	3	4	5	6	7	8
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	107	10	16	17	15	10	19	11	9
IL Method mean	3.35	3.83	3.46	2.95	3.83	3.11	2.72	4.11	3.20
CL Method mean	3.36	4.20	3.50	3.18	3.67	3.90	2.84	3.09	2.78
Critical t value @ p = 0.05	1.97	2.08	2.05	2.03	2.04	2.11	2.03	2.10	2.18
t-test value	0.04 NS*	0.98 NS	0.10 NS	0.61 NS	0.54 NS	1.52 NS	0.29 NS	2.16 S†	0.65 NS

* NS = Not significant
† S = Significant

and 4.00) than did the respective IL groups (2.77 and 2.78). Thus, institution #3 and #5 CL students felt more strongly that the course helped them learn how to work well with others than did the institutions' IL students.

DISCUSSION

When analyzing attitudes toward teamwork and courses, a few institutions showed differences between the two learning methods, but none of the differences was statistically significant when all students were analyzed together. Questions #1-30 on the attitude questionnaire explored student attitudes toward teamwork in both the workplace and classroom settings in general. No significant difference was seen between the means for the IL students and CL students. Means were also compared for each of the eight participating institutions, but none of these differences was significant either. Therefore, it appears that CL students did not develop any stronger positive attitude toward teamwork than did the IL students. Since many CLS instructors are choosing CL methods for their classes because of the belief that this will enhance student attitude toward teamwork, this study's findings raise concerns. Further research is required to see whether these results can be replicated and to provide broader validation of the attitude questionnaire instrument.

Questions #31-35 on the attitude questionnaire examined students' attitudes toward the courses they had just completed to determine whether learning method had an effect. Anecdotal reports in the literature have suggested that CLS students who participate in CL are more satisfied with their courses than are their traditional IL counterparts. For the majority of the students in this study, learning method did not affect their attitudes toward the subject matter, enjoyment of the course, satisfaction with personal class performance, impression that the learning method helped their performance, or understanding of how to work well with others. Where there were individual institutional differences, they were fairly evenly split between IL students and CL students. The only institutions whose *cooperative* learning students agreed significantly more strongly to any of these statements were institutions #3 and #5. In fact, for institutions #3 and #5, the CL group means were higher than the IL group means for all five questions, even though the differences were only significant for several of the questions (questions #31, #32, and #35 for institution #3 and questions #33 and #35 for institution #5). Interestingly, the two faculty members involved at these institutions each reported over ten years experience with CL in their CLS classrooms. None of the faculty at the other institutions reported that level of experience with CL; in fact most had very limited experience with this learning strategy prior to the study. This suggests that perhaps instructor comfort level and facility with a learning method are necessary to effect any change in attitude.

It is particularly interesting that there were no significant differences between CL and IL for the 213 students as a whole and for six of the eight institutions for question #35: "This course gave me a better understanding of how to work well with others."

Table 6. Comparison of mean scores of cooperative learning (CL) vs. individual learning (IL) students for agreement with the statement, "This course gave me a better understanding of how to work well with others."

	All Students	Institution Number							
	n = 213	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
IL Method n	106	12	13	22	18	9	18	9	5
CL Method n	107	10	16	17	15	10	19	11	9
IL Method Mean	3.08	4.25	3.15	2.77	2.83	2.78	2.78	3.78	2.80
CL Method Mean	3.34	4.00	3.38	3.53	3.20	4.00	2.68	3.45	2.89
Critical t value @ p = 0.05	1.97	2.08	2.05	2.03	2.04	2.11	2.03	2.10	2.18
t-test value	1.88 NS*	0.75 NS	0.78 NS	2.69 S†	1.42 NS	2.78 S	0.31 NS	0.71 NS	0.12 NS

* NS = Not significant
† S = Significant

It might be expected that IL students would not agree strongly with this statement. However, one might anticipate that a CL setting would better teach students to work well together. Yet, it was only at institutions #3 and #5, that the CL students agreed more strongly with the statement than did the IL students.

The results of this study may seem at odds with anecdotal reports about the value of CL in CLS education. However, it is not surprising that some instructors have seen positive changes in attitude in their own CL classrooms. The current study also revealed some positive effects of CL in certain classrooms. This study does underscore the need to be cautious when attempting to generalize from one instructor's experiences to all CLS classrooms.

Many instructor, student, and group dynamic variables can influence the success of any learning method. For example, several participating faculty members reported that their CL students resisted active participation in their learning, preferring to be 'spoon-fed' information instead. One participating faculty member reported that the students in her IL class seemed naturally more outgoing and that students in the CL class were very quiet and had difficulty adapting to this learning method. This may have affected outcomes in this study, and could limit generalization to other CLS classrooms. Instructor attitudes can also affect outcomes; for a faculty member who strongly believes in the value of CL and inadvertently communicates this to a class, the Hawthorne Effect may shape student attitude.[20]

Another factor to consider is that perhaps CL really does have these positive effects. However, the IL method in CLS education could be tainted by the influence of small class size. Typically, enrollment in CLS programs is low. These students often spend many hours together in their CLS courses and develop into close-knit groups. Perhaps these small classes already function extemporaneously as CL groups so that the differences between these IL classrooms and planned CL classrooms are negligible. Future studies might compare how much time IL versus CL students study together outside of class.

Out of necessity, the courses taught by participating faculty members were offered only once annually and did not have multiple sections. To minimize the impact that extraneous variables have on the results of this study it would have been better if the CL versus IL comparisons could have been made in separate sections of the same semester offering of a course. Perhaps future studies could find a way to do this.

It would be useful to do further research on the impact of student and teacher variables on the outcomes of CL vs. IL methods. This study found some evidence that CL students whose instructors had at least ten years experience with CL had stronger positive attitudes toward the courses than did their IL peers. The influence of teacher facility with CL techniques should be explored in greater depth. Other teacher variables such as personality and belief in one learning method over another are worthy of further study.

This is the first study of its kind to use a multi-institutional empirical evaluation of attitudinal effects of CL in CLS education. Overall, it appears that CL and IL produced similar teamwork attitudes. This finding would suggest that CLS faculty members may comfortably use whichever learning method they prefer without fear of adversely affecting student attitudes toward teamwork. For those faculty members who seek to enhance student teamwork attitude, this study unfortunately did not provide support for CL as the vehicle. Instructors may have more success with CL after they have had years of experience with this learning strategy. Perhaps it takes multiple student exposures to CL to affect a positive attitude toward teamwork, or perhaps attitudinal changes are not obvious immediately after the CL experience. Further studies, particularly prospective cohort studies to examine attitudes toward teamwork after graduation are needed to demonstrate the validity of using CL in CLS education.

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