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GREAT MINDS DON'T THINK ALIKE, THEY COMMUNICATE TO COLLABORATE

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ABSTRACT

Historical and contemporary studies focusing on collaborative learning have cited benefits regarding student performance and retention of course content. However, few researchers have focused on the usage of collaborative testing in introductory courses and more specifically the perceptions of the experience as communicated by students. To help address this gap in the literature, the authors explored students' perceptions of collaborative testing in introductory courses (communication sciences and disorders and human resource development) at two universities. Study results indicate usage of collaborative testing in introductory courses helps students to process course information at a deeper level and learn effective communication strategies to work cooperatively with peers. Implications for instructors are also addressed to aid in effective implementation of this learner-centered teaching strategy in introductory courses.

KEYWORDS*:* Collaborative learning; collaborative testing; group testing; learning strategies; introductory courses, scholarship of teaching and learning

INTRODUCTION

As the workplace continues to become more focused on technology, resources, budgets, and efficiencies, collaborative and group efforts are more commonly used to complete tasks and accomplish goals. Employers not only anticipate but expect employees to work together in teams or groups to meet and exceed performance goals. Interestingly, instructors often choose to integrate learning strategies focusing on individual efforts when preparing students (future employees) for their roles in the workplace. Such learning strategies do not necessarily require students to interact, engage, and collaborate with their peers. Recognizing this, one may ponder whether collaborative learning strategies or individual learning strategies are more effective in preparing students to work in contemporary work environments. As experimental and longitudinal research may be needed to explore these phenomena, the usage of collaborative learning strategies, such as collaborative testing, should not be shelved in anticipation of collective academic resolve.

Connected Literature

Literature pertinent to learning theory, learner-centered instruction, and collaborative learning and testing in higher education settings was reviewed for this research. Each of these facets of literature regarding learning provides the framework for the importance of focusing on the learners' needs and keeping them as the focal point of instructional methods. Learner-centered approaches allow students to become partners in their learning experience, while exploring with the instructor what will help them better understand and enhance learning (Weimer, 2013). Collaborative learning involves inclusive efforts of the instructor and students to create knowledge (Davidson & Major, 2014). Interconnected is collaborative testing, which is fundamentally rooted in reflection about what has been learned while engaging and soliciting the same from classmates or peers.

Related Theories

Two underpinning theories were primarily utilized for this study of collaborative testing. The first of which was the theory of student involvement (Astin, 1984). The theory of student involvement adheres to a psychological viewpoint, wherein student involvement and the investment of energy are essential to bring about the desired learning and development in a particular curriculum. The second foundational theory is the social constructivist theory credited to Lev Vygotsky (1978). Social constructivist theory, also known as the social development theory, stresses the fundamental role of social interaction in the development of cognition and focused on the significant role that community plays in the process of generating knowledge. This concept is referred to as co-operative or collaborative dialogue by Vygotsky. Vygotsky's work is based on two main principles of cognitive development: a) the more knowledgeable other (MKO) and b) the zone of proximal development (ZPD). The more knowledgeable other refers to someone who has a better understanding of a higher ability level than the learner with respect to a particular task, process, or concept (Vygotsky, 1978). Newer perspectives have been cited in the literature e.g., the cognitive developmental perspective which draws heavily on the constructivist theory and purports that ideas revealed in groups help individuals to discuss pros and cons to test their ideas. There is also the Positive Interdependence Theory (Johnson, Johnson & Smith, 1998) which specifies that students may be motivated to unite around a common goal.

Learner-Centered Instruction

Learner-centered experiences integrated early in the curriculum, particularly in introductory courses, are associated with long-term improvements in learning (Derting & Ebert-May, 2010). Additionally, implementation of learner-centered experiences may also provide benefits to students which extend beyond the class where the learner-centered experience occurred (Derting & Ebert-May, 2010). Bearing these things in mind, introductory course instructors choosing to adopt learner-centered instruction have a unique opportunity to shape the students' viewpoint regarding their success in the major or discipline.

Regarding class size, smaller classes were determined to be associated with more learner-centered instruction and delivery (Walczyk & Ramsey, 2003). As a result, Walczyk and Ramsey (2003) advocate scaling down large introductory courses, specifically in science and math, to smaller classes in order to provide students with more

positive experiences. However, larger classes are also conducive to learner-centered experiences and instructors can successfully implement such strategies therein (Blumberg, 2009).

Researchers have asserted that commitment, willingness, and risk are associated with implementing learner-centered strategies in undergraduate courses (Walczyk & Ramsey, 2003). Commitment and risk enter the dialogue surrounding learner-centered instruction because learner-centered instruction comprises a variety of instructional methods and shifts the role of the instructor from teacher to facilitator (Blumberg, 2009). To aid instructors in this paradigm shift, Blumberg (2009) provides a comprehensive guide for faculty seeking to implement learner-centered instruction in college courses. Embracing learner-centered instruction requires instructors to: change their teaching method; focus more on pupils' needs; incorporate opportunities for feedback and reflection; partner with students; and enlighten students to become intrinsically motivated to learn (Blumberg, 2009; Weimer, 2013).

Collaborative Learning & Testing

The purpose of collaborative learning is to enable students to unite and work towards a common academic goal (Gokhale, 1995). As previously stated, collaborative learning involves the combined efforts of students and instructors. As such, these collective efforts may be applied in multiple forms. Student interactions perpetuate collaborative learning; hence, the application to the learning environment may come in the form of various group activities. Instructor and student partnerships also promote collaborative learning; these may be applied to the learning environment through the usage of learning contracts (Sheridan, Byrne, and Quina, 1989). Collaborative learning strategies may be applied in any area of study, as Sheridan, Byrne, and Quina (1989) provided clear examples of application in economics, zoology, chemistry, and English.

While research on collaborative learning often focuses on the positive aspects, there are dissenting views on the topic. For example, Shea (1995) describes various issues with collaborative learning from both the instructor's and students' points of view. Regarding students, Shea asserts that the prevailing issue is they dislike the difficulty of working in groups and would rather work solo. Shea further cites resentment for carrying along weaker students, lazy students or colleagues failing to do their share, and inability to make scheduled meetings as issues for students engaging in collaborative learning. Shea (1995) additionally maintains that learning is not necessarily automatic, as groups tend to partition work rather than work collaboratively throughout the entire project/assignment. Hence, students typically work on aspects of the project they feel most comfortable addressing. Dressler, Matthews, and McDown (2009) identify issues similar to those identified by Shea (1995). However, Dressler, et al. (2009) asserts that students shifting from a competitive nature to a collaborative nature, along with having to take increased responsibility for their own learning as issues needing attention.

Planning is required in order to implement collaborative learning strategies. However, it is essential for instructors to understand that there is no requirement regarding the extent to which these strategies must be implemented for learning to occur. Accordingly, the instructor's discretion and level of comfort determine the extent to which collaborative learning occurs in the classroom.

Although the concept of incorporating collaborative and group strategies in learning is not new, few contemporary writings focus on collaborative testing practices, student and instructor perspectives of collaborative testing, and collaborative testing outcomes (Clinton & Kohlmeyer, 2005; Srougi, Miller, Witherow, & Carson, 2013; Wiggs, 2011). Perhaps this is so because instructors customarily use individualized testing to assess learning. However, an alternative to the traditional, individual testing approach is collaborative testing. Collaborative testing allows students to work together to complete a test (Russo & Warren, 1999). Collaborative testing is a strategy used in collaborative learning environments. Collaborative testing has been used in various undergraduate courses including accounting, education, English, chemistry, molecular biotechnology, and nursing to name a few (Clinton & Kohlmeyer, 2005; Ley, Hodges, & Russ, 1995; Russo & Warren, 1999; Srougi, Miller, Witherow, & Carson, 2013, Wiggs, 2011).

There is no specific format when incorporating collaborative testing. The collaborative testing schema is determined by the instructor and testing may be completed in class or outside of the classroom. Collaborative testing may encompass a wide range of formats including: a) combinations of collaborative take-home tests and individual in-class tests (Srougi, Miller, Witherow, & Carson, 2013); b) collaborative essay tests

(Muir & Tracy, 1999); and c) simultaneous collaborative and individual testing (Wiggs, 2011). In addition, the instructor determines if the groups are ad hoc or fixed and self-selected or instructor-selected (Clinton & Kohlmeyer, 2005).

Usage of collaborative testing has been found particularly useful in introductory courses, as instructors seek to reinforce core, foundational concepts in their respective disciplines (Allison, 2014; Pace, 2014; Shana, 2014). Although some students may be leery and doubtful of the nontraditional collaborative testing approach, prefer to work alone, and seek to avoid group work, doing so avoids and limits insight and perspective from other students. Solo practices such as these often do not reflect what is experienced and promoted in the present-day workplace. Students, as well as instructors, participating in collaborative testing responded favorably when questioned or given the opportunity to reflect on the experience (Muir & Tracey, 1999; Srougi et al., 2013). Even though the students' disposition towards collaborative testing has been favorable, Cortright, Collins, Rodenbaugh, and DiCarlo (2003) provide evidence that collaborative testing enhanced student performance and improved retention of course information. Further, Cortright at al. (2003) concluded that collaborative testing is useful for assessment and learning. Interestingly, the work of Cortright at al. (2003) also helps instructors to embrace collaborative testing by challenging the view of collaborative testing whereby the researchers emphasize that the approach can help teachers teach and students learn. Elsewhere, Leight, Saunders, Calkins, and Withers (2012) reported that collaborative testing improved student performance but did not improve content retention in a large-enrollment introductory biology course.

Closely related to collaborative testing is partner testing. Partner testing is an approach that allows a student to complete a test or examination with a partner. Partner testing may be particularly useful for developmental students and aids in learning by enhancing students' commitment to course material, creating study and dialogue opportunities outside the classroom, and helping students develop new learning and test-taking skills (Ley, Hodges, & Russ, 1995). Although implementing collaborative and partner testing can increase instructor preparation time, students perceived these testing methods as positive experiences aiding in understanding course content (Ley, Hodges, & Russ, 1995).

Cooperative Learning

Whereas the connected literature primarily focuses on learner-centered instruction and collaborative learning, we cannot ignore cooperative learning. As cooperative learning is closely related to collaborative learning, Davidson and Major (2014) seek to distinguish cooperative learning and collaborative learning by identifying essential features and goals of each approach. Further it is the adeptness of Johnson, Johnson, and Smith (1998), as well as Davidson and Major (2014), which particularly help us recognize the juxtaposition of these two approaches. There are five elements that are critical to cooperative learning (Johnson, Johnson, & Smith 1998). These include positive interdependence, individual accountability, promotive interaction, social skills, and group processing. Accordingly, Johnson at al. (1998) provides clear guidance regarding how the instructor should proceed when integrating these elements into the collaborative learning process.

Purpose

Two instructors of introductory courses, one in speech-language pathology and the other in human resource development, endeavored to find a way to engage students in a collaborative experience that would promote learning, compel focused discussion, and encourage peer communication and interactions. To meet these objectives, the instructors decided to implement collaborative testing as a means of reviewing and reinforcing foundational content taught at the beginning of the semester. The purpose of this study was to explore students' perceptions of collaborative testing in introductory courses at two universities. In this work we also seek to generate, expand, and share knowledge regarding collaborative testing, particularly students' perceptions, and its usage in introductory courses.

Whereas student learning outcomes are more likely perceived as a stronger indicator of the usage of collaborative testing in the introductory courses, this study examines students' perceptions of collaborative testing. This is due to the manner in which collaborative testing was utilized in the introductory courses. In both classes, the instructors used collaborative testing after the students had completed the test individually. In addition, the collaborative test did not replace the original test score earned by the students. Hence, in both classes collaborative testing was utilized as an auxiliary

pedagogical strategy. Further, students engaged in collaborative testing in an effort to build foundational knowledge in introductory courses and to communicate ideas clearly to one another. Students' perceptions of this experience provide insight into how collaborative testing may be used in introductory classes. A profusion of feelings, interactions, self-examination, and suggestions emerged from the students' participation in collaborative testing. The research question formulated to execute this study was: What are the perceptions of students in introductory classes regarding collaborative testing?

METHODS

Participants

The population for this qualitative study consists of 33 students enrolled in an introductory course at a large university (15,000 students or more) in the Southeast, and 22 students enrolled in an introductory course at a medium sized university (5,000 – 15,000 students) in the Midwest. For identifying purposes of this study, the introductory course at the large university will be referred to as Class I with introductory course content focused on clinical practice in speech-language pathology and audiology. Accordingly, the introductory course at the medium sized university will be referred to as Class II throughout the study with course content focused on foundational principles and characteristics of human resource development. Approval for this study was obtained from the Institutional Review Board at both institutions. Students were not subject to harm or adverse action, and all information provided was voluntary.

Midterm Examination Instructions

Collaborative testing was utilized with undergraduate students enrolled in introductory courses at the two universities after students individually responded to questions that were cumulative up to the mid-term of the semester. The midterm exam was a closed book exam that was timed and given electronically during the usual class meeting time. Both instructors proctored their exams at their respective universities. Students used their personal laptops to complete the individual exam. Both exams consisted of a total of 35 questions given in the format of multiple choice and true/false questions. Students received immediate electronic scores after completing the test sixty minute. Moreover, students were instructed to complete the exam individually without any study aids.

Group Collaborations

After completing the individual exam, students in both Class I and Class II were given an opportunity to collaborate with their peers to enhance processing the course content at a deeper level of understanding. The collaborative exam in both Class I and Class II consisted of the same questions as the mid-term exam. Students in Class I and Class II were placed in instructor assigned groups to complete the collaborative group test.

Class I students were provided the collaborative group test in paper format while Class II students received the group test in an electronic format. They were instructed to select one group member to submit/record the group's answers. Both instructors provided no additional instructions regarding whom the groups should select to submit their answers. Students were given 20 minutes to work in groups to complete the collaborative test and were allowed to use aids (e.g., notes, etc.).

Upon completing the collaborative tests in Class II, each group received a score and was allowed to view the questions missed. After all groups completed the collaborative test, the instructor facilitated a class review of the collaborative test. During this review, all students were encouraged to participate by sharing their group's answers and the rationale for their answer choice. The correct answer was confirmed by the instructor and key points were reinforced.

After all students completed the individual exam in Class I, the students reviewed the exam questions with their assigned group members of the class. After the students completed the exam as a group, they turned in the answer sheets to the instructor. The answer sheets were dispersed to other group members to check for the correct answer choices while the instructor announced the answers by the number of the question. After all correct answers were read aloud to the class by the instructor and answer sheets were graded by their peers in other groups, discussion ensued about the reasoning used by those who selected the correct and/or incorrect answers. This approach was used to aid in student learning and development. The two primary differences in the processing of this collaborative testing was that Class I completed the individual and group testing on the same day as opposed to Class II completing the group testing on the subsequent class meeting. The second difference was that Class I received a hard copy of the exam during the collaboration and Class II used an electronic copy. Both exceptions were made due to cancellation of classes at the southeastern

university due to weather conditions and the need to complete the process during one class session. Participation or non-participation in the group did not have a negative impact on individual grades of the students. However, students were able to add additional points to their mid-term grade by participating in this collaborative group learning experience. Further, students were not aware at the outset of this experience that additional points could be added because the instructors wanted them to freely express their views.

Evaluation

An evaluation was given to the students to complete individually after the collaborative group testing exercise. Responses were recorded to determine if the exercise achieved the goal of the instructors based on the students' perceived efficacy of working in small groups to foster a deeper level of understanding key concepts covered in class and tested on the midterm exam. The following seven questions were asked immediately following the exercise: 1) How many group members did you have in your group? 2) Prior to this activity, have you ever been allowed to complete a test as a group? 3) Did you find working in a group to be helpful for this activity? 4) Did all members contribute equally? If no, please explain. 5) What did you like the most about this group testing activity? 6) What did you like least about this group testing activity? 7) In your opinion, what was your role in this group activity?

Students' Blogs

Students were given the opportunity to voluntarily blog about their experiences in completing the collaborative group exercise in class. They were instructed to share additional thoughts and observations about the way the exercise was done in class as well as ways to improve it for future students. The instructors of Class I and Class II agreed on and shared the same instructions to students. They were given the following topics to further reflect on while blogging– (1) The presence or absence of leadership in your group, (2) How, if at all, did the exercise help you process the information at a deeper level, (3) What you would have done with additional time for the exercise, (4) How your group arrived at the group answers, (5) Any other pertinent points to the collaborative group testing exercise.

RESULTS

Demographics

There were 33 students in Class I and 22 students in Class II. The college classification of the students in Class I was as follows: 10% freshmen, 57% sophomores, 29% juniors and 5% seniors. One hundred percent of students in the Class I indicated that the class was required. In Class II, students were classified as follows: 28% freshmen, 28% sophomores, 11% juniors, and 28% seniors. Seventy-eight percent of students reported that the class was required of them.

Students were asked to respond to a post activity evaluation after the collaborative group testing exercise. The evaluation was voluntary with 65% of students in Class I and 77% of students in Class II responding to the evaluation. The average group size for both classes consisted of four students. Eighty-one percent of students in Class I vs. 67% in Class II indicated that they had not used collaborative group testing prior to this exercise. In addition, 100% of students in the Class I vs. 89% of students in Class II felt that the activities were helpful.

Students' Perceptions of Collaborative Testing

Students were given the opportunity to respond to open ended questions on an evaluation and later blog about their perceptions of the collaborative effort. Twelve percent of students in Class I and 50% of students in Class II responded to the blog. Five themes were apparent based on the questions asked and responses received from the students. The themes were as follows: (1) group dynamics, (2) perceived benefits, (3) allotted time, (4) group strategies, and (5) future improvements. The following responses including examples from the evaluations, as well as the blog are provided to support these themes.

Group dynamics. Specific leadership instructions were not given to students in Class I or Class II but the instructors wanted to know whether a person emerged as a leader of the group. In sum, Class I students commented and/or blogged that they worked well together, helped one another and contributed equally. Regarding the emergence of a group leader, Class II students indicated that the student who had the laptop became the leader and kept the group on track. Class II students shared mixed views on group dynamics. Whereas some students were engaged in their groups' work and efforts to complete the collaborative group test, others were not and minimally contributed to discussions. Overall, Class II students were amenable to working in groups, had a positive

experience, and felt group members contributed equally. However, when this was not the case (i.e., group member(s) not sufficiently contributing), some feelings of frustration emerged. Some of the specific comments made by students in the evaluation and blog responses were as follows:

There is a strong presence of leadership in our group from all of our members because we are all dedicated to succeeding in the class and want to put forth our full effort into doing well! (Class I blog response)

The group did not have one leader; therefore, I guess that means there was an absence of a leader in our group, but that worked to our advantage. If one of us had a different reasoning for a question, none of us were too shy to step up and explain our point of view on the question and in that way we all took turns leading the question discussion. (Class I blog response)

The leader of the group was subconsciously the person in charge of the laptop. That person set the pace of the test and took charge. (Class II blog response)

I feel that the three girls worked very well together. I don't really know if the boys knew what we were doing or really understood the information. I feel that we all wanted to contribute to the test and tried to. (Class II blog response).

Perceived Benefits. Overall, the Class I evaluation and/or blogs indicated an appreciation for being able to discuss responses with peers and to process the information at a deeper level. This is consistent with the Student Involvement theory described by Astin (1984). All of the students in Class I agreed that the exercise was helpful. They appreciated the ability to work with others in the class to hear their thoughts and reasoning and to discuss different concepts learned in class. Others expressed that it was great because of the varied ages and experiences in the class and that it allowed them to share thoughts and perspectives on each question. Students in Class II overwhelmingly perceived the collaborative testing activity beneficial, and even expressed a desire to be allowed to use this testing method in the future. The students' views of the perceived benefits align with previous research, as they expressed current and future benefits of participating in collaborative testing. Students' comments in the blog postings indicate the collaborative testing activity helped them in a variety of ways including: understanding the material, reaching goals, increasing professional skills (e.g., leading, solving problems, and communication), sharing knowledge and ideas, gaining new perspectives, and offering a chance for redemption. Some students perceived the benefits as giving them a glimpse of their future workplace environments, acknowledging working with individuals from different cultures. Specific comments were made as follows:

We had all the information we each knew on the subject matter, and then combined, we knew more and had a better opportunity to answer the questions and were more confident that we got them right. (Class I evaluation response)

I think that talking it through as a group was very beneficial to all of us because we each had questions about certain topics that we didn't understand, but when we talked it through it made it clearer. (Class I blog response)

We were able to see what we really knew and what confused us… (Class II evaluation response)

The exercise did seem beneficial to the understanding of the content that I missed. It is easier to interact with others who may think about the questions differently than I do. (Class II blog response)

There are a lot of benefits of being one of the group members. However, sharing the ideas and opinions with your group members will help the group to reach their goals easily and save a lot of time. Also, it could help to increase a lot of the professional skills such as leading, solving problems, communication and a lot of skills that could help you while you are in the workplace… (Class II blog response)

Allotted Time. The collaborative test was timed; students were allowed 20 minutes to complete the test. Class I collective responses confirmed that enough time was allotted for this exercise. However, additional time would have been beneficial for greater discussion of each question. Students in Class II indicated the need for additional time and stressed how the additional time could have improved the collaborative testing experience. Even though students were given a specific timeframe to collaborate on the test, additional time was used to review the test *as a class after all groups completed*. Students did not consider the time used during the class review of their collaborative efforts as being time allowed to work or engage in the collaborative testing experience. Time was considered by the students to be an element impacting

the collaborative testing experience. Consequently, Class II students stressed time to be one of the aspects of the collaborative group testing experience *least* liked.

With additional time for the exercise, we would have maybe gone through the tricky questions again and talked through them more. Also we would have discussed what was not on the exam and what we thought would have been good test questions. I think our group would have gone through the questions and picked out which ones were a good measure of how well we learned the material and which ones were not like that. (Class I blog response)

More time could have allowed my group the opportunity to go back over the questions and read them slowly because usually speed reading the questions and answers often leads to careless mistakes. Also, with more time we could have continued our discussions on the few we had answered differently. (Class I blog response)

I think the time allotted was sufficient. (Class I blog response)

…time restraint was pressuring. (Class II evaluation response)

Overall, I feel with that if we would have had more time each one in our group could have processed the information at a deeper level and did better on the test. (Class II blog response)

If I had been provided with a little extra time for the exercise, I would have taken that time to go back through and review each and every question and answer just to make sure that we had read all of the questions correctly and selected the right answer. (Class II blog response)

Group strategies. During the collaborative testing activity, groups were not allowed to collaborate with other groups. Therefore, collaborative groups employed various strategies to complete the test. Some groups held brief discussions before giving a final answer, while others approached each question individually then sought agreement on a final answer. Even though some Class II groups may have resorted to the divide and conquer method, some groups simply discussed answer options and eliminated wrong answers. Regardless of the strategy employed by each group, students in Class I consistently indicated the need for consensus or group agreement. Whereas, Class II students highlighted the value of discussions and sharing prior knowledge in their strategy. In addition, the interactions among peers in the group were also indicated by Class II students to be an element *liked most* about the collaborative group testing experience.

My group members and I just talked through the answers together. We collectively eliminated answers we knew were incorrect, and we had discussion about possible correct answers. (Class I blog response)

The questions that were controversial in terms of differing opinions required looking at each of the options and working together to use the process of elimination which would then lead to consensus for the answer we would choose. (Class I blog response)

Group answers were reached by each person stating what they believed the answer was and why. (Class II blog response)

One of the group members had a good grade on the first test so she explained and helped us understand what we ended up doing wrong… we divide it up each one of us had a chapter… (Class II blog response)

Future improvements. Students in both classes provided input on how to improve the collaborative testing experience. Improvement suggestions ranged from transforming the activity to a game to increasing the amount of time to complete the activity. However, pragmatic, constructive suggestions focused on conducting the activity prior to the exam rather than afterwards.

I think this would have been more helpful as a review activity instead of a follow up to the test. (Class I evaluation response)

I think it would have been more helpful to do something similar before the exam (at an earlier date), rather than after. (Class I blog response)

Use as a method of review before an exam (Class II evaluation response)

Additional Comments

When given the opportunity to provide *additional feedback* in the blog regarding their collaborative testing experience, some students in Class I expressed that this exercise would be helpful for other classes. Class I students also reiterated it would have been more helpful to do a similar activity before the exam. Moreover, Class II students reiterated their affinity for the collaborative

testing experience, the benefits to them, and their preference of collaborative testing over individual testing.

DISCUSSION

This study focused on student perceptions of collaborative group testing strategies utilized in two distinct classes (one in the health sciences and the other in human resource development) at different universities. Accordingly, the instructors endeavored to identify and explain the perceptions of students in introductory classes regarding collaborative testing in class settings with different foci. As students in both Class I and Class II gravitated to the approach and perceived collaborative testing as beneficial to learning, this study supports the finding of Cortright et al. (2003) that students retained course information significantly better when they were able to discuss questions and responses in small groups after taking individual exams (although we did not formally or statistically assess information retention in the present study). Further, the format (collaborative testing completed *after* individual testing) used in the study allowed students to receive timely feedback from peers and the instructor. The importance of timely feedback was also highlighted as important for retention of course content (Cortright et al., 2003), and likewise this format was used in the collaborative testing study of Cortright et al. (2003) wherein the connection to learning and retention was supported with evidence.

Five themes also emerged from student perceptions: (1) group dynamics, (2) perceived benefits, (3) allotted time, (4) group strategies, and (5) future improvements. One should recognize that group dynamics will vary (e.g., gender, leadership skills, cooperation); however, placing strict protocols on the groups may create an unnecessary barrier to groups determining their strategy for communicating and completing the collaborative test. Nevertheless, the benefits perceived by the students (e.g., gaining a perspective on the future work environment, working with and for persons from different cultural backgrounds, use of effective communication strategies) serve as a catalyst and motivator for the instructor and students to engage in the collaborative testing. The allotted time to complete the collaborative test was perceived as somewhat problematic. However, the allotted time should be carefully determined due to the fact that groups must stay on task and avoid getting entangled in discussion not germane to the course content. Group strategies may initially appear to be minor; nevertheless, this element emerges as a critical component to the success of the group which can greatly impact group dynamics, communication, collaborative testing benefits (outcomes), and time used.

These themes help bring into focus how collaborative testing may be implemented in introductory courses across disciplines, as well as how students can take a more active role in their learning. As asserted by Johnson, et al. (1998), promoting positive interdependence is an essential element in cooperative and collaborative approaches. The future improvements articulated by the students in the study revealed their willingness to further engage in collaborative testing (and learning) in introductory courses and that modifications to the process could yield additional perceived benefits. In summary, these themes provide a deeper understanding of students' perceptions of working collaboratively and communication in groups when an assessment is involved.

Implications for Instructors

Based on prior works of Blumberg (2009) and Weimer (2013), we consider collaborative testing a learner-centered approach. Additionally, this consideration takes into account that a collaborative testing experience can challenge students' self-efficacy. Moreover, we are led to this resolve because the collaborative testing activity permitted students to communicate and engage in work that allowed them to demonstrate success and it was reinforced by teaching that lets students acknowledge their responsibility for learning (Weimer, 2013). Implementing collaborative testing (a learner-centered teaching strategy) requires careful thought and deliberation. As a result, instructors may have to place students' needs in the classroom ahead of their own. Instructors should quickly be made aware of the time commitment and preparation needed to determine their desired collaborative testing. At a minimum they should consider:

- communicative intent (strategies for productive communication of ideas);
- format (e.g., combination group and individual testing, simultaneous individual and group testing, etc.);
- method (e.g., online/electronic, paper, oral, etc.);
- groupings (e.g., ad hoc or fixed; self-selected or instructor-selected); and
- timeframe

Coupled with regard to the previously listed considerations, instructors are encouraged to evaluate the collaborative testing activity. Doing so will allow the instructor to gain insight into the students' reaction and future planned action. Additionally, insight into students' perceptions of what worked well and what could be improved to aid in their learning experience could also be gained through evaluation. We especially encourage evaluation if the instructor plans to conduct collaborative testing multiple times during the course.

Instructors considering collaborative testing should also consider working with a partner in this endeavor. Partnering with other instructors teaching different sections of the same course, instructors teaching courses at the same level (i.e., introductory courses), or interested colleagues can aid in generating ideas that support effective communication and implementation of collaborative testing. In addition, interdisciplinary partnerships are also encouraged when instructors are able to find common elements in the courses. An example of a common element in the present study was the courses were introductory courses in both disciplines. By partnering with a colleague(s), instructors are able to have synergistic dialogue and support from peers. Partnerships are helpful in classes of all sizes.

LIMITATIONS, FUTURE RESEARCH, AND CONCLUDING SUMMARY

Limitations

Limitations of the study were observed with Class I using a hard copy of the exam while Class II completed the collaborative exercise electronically. Secondly, Class I took the exam on the same date as the collaborative group testing activity while Class II completed the collaborative test on the following class period after the individual test was completed. It is noteworthy that Class I took the exam on the same day only because of weather conditions causing a class session to be cancelled. This, of course, was a necessary modification and beyond the control of the researchers. Even though Class I had more students to participate in the collaborative testing their blog responses were few. The instructors determined that these subtle differences were acceptable though not ideal for analyzing the similarities and differences between the perceptions of the students in Class I and Class II. The most rewarding aspect of this exercise to the instructors was to watch how the students deliberated about answers and reasoned with one another to defend their perspectives.

Future Research

We fully encourage future research on collaborative testing in introductory courses, primarily to address learning outcomes and to promote best practices among users. Based on the findings of this study, we recommend future research on collaborative testing further examine: a) learning outcomes in introductory courses; b) group dynamics and communication; c) the differences in student perspectives of collaborative testing using different testing methods (i.e., online/electronic, paper, oral, etc.); d) identification of the skills (e.g., communication, leadership, listening, etc.) students perceive collaborative testing helps to build or enhance that will aid in their success in the workplace; and e) how partnering with colleagues can aid instructors in implementing learner-centered approaches (e.g., collaborative testing). As these areas are researched and new knowledge is generated regarding the purpose, significance, and usage of collaborative testing, a greater appreciation for the practice will develop. Consequently, future research in the areas will enhance the practice and better address the learning needs of students and aid instructors in determining efficiencies when implementing collaborative testing. Student success is at the core of collaborative learning strategies and instructor awareness of these perceptions enables them to accomplish the core mission of teaching and learning.

Concluding Summary

This study revealed that students enrolled in the introductory courses expressed highly favorable perceptions of the collaborative group testing process utilized in their respective disciplines. From the students' perspectives in Class I there were no leaders that emerged within the group. Conversely, in Class II, the person with the control of the computer functioned as a leader as they worked together with one person capturing group answers on the computer. Overall, students expressed the positive benefit of sharing ideas and opinions which led to a deeper understanding of the information. In addition, some even cited that they learned to understand and appreciate how their classmates thought through questions. When asked about the amount of time provided to complete the collaborative testing, the majority of the students in both classes indicated that more time would have been helpful. Students in Class I and Class II agreed

that the exercise would be good to use in other classes and as a review method before an exam.

Although the findings of the current study are not universally generalizable, we conclude that the findings are significant to the practice of teaching and learning. Further, we perceive that this work may inspire educators to inherently seek to include more learner-centered activities in their pedagogy. As the usage of collaborative testing in introductory courses grows, further study can commence examining communicative intent, learning outcomes, and student success.

REFERENCES

Allison (n.d.). Group testing-taking options to consider. [Web Blog Comment]. Retrieved from http://www.facultyfocus.com/articles/teaching-professor-blog/group-testing-taking-options-consider/

Astin, A. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25*(4), 297–308.

Blumberg, P. (2009). *Developing learner-centered teaching: A practical guide for faculty*. San Francisco, CA: Jossey-Bass.

Clinton, B. D. & Kohlmeyer, J. M. (2005). The effects of group quizzes on performance and motivation to learn: Two experiments in cooperative learning. *Journal of Accounting Education, 23*, 96-116.

Cortright, R. N., Collins, H. L., Rodenbaugh, D. W., & DiCarlo, S. E. (2003). Student retention of course content is improved by collaborative-group testing. *Advances in Physiology Education, 27*(3), 102-108.

Davidson, N., & Major, C. H. (2014). Boundary crossings: Cooperative learning, collaborative learning, and problem-based learning. *Journal on Excellence in College Teaching*, *25*(3&4), 7-55.

Derting, T. L., & Ebert-May, D. (2010). Learner-centered inquiry in undergraduate biology: Positive relationships with long-term student achievement. *Life Sciences Education, 9*, 462-472.

Dressler, W., Matthews, C., & McDown, L. (2009). Collaborative learning: An innovative educational approach. University of Hawaii. Retrieved from: http://www2.hawaii.edu/~dressler/CLbenefits.html

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education, 7*(1). Retrieved from http://ClassIIholar.lib.vt.edu/ejournals/JTE/v7n1/gokhale.jte-v7n1.html

Gubera, C. Aruguete, M. (2013, December). A comparison of collaborative and traditional instruction in higher education. Retrieved from *Social Psychology of Education: An International Journal*, 16(4), 651-659.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). Cooperative learning returns to college what evidence is there that it works? *Change: The Magazine of Higher Learning, 30*(4), 26-35. DOI: 10.1080/00091389809602629

Leight, H. Saunders, C. Calkins, R., & Withers, M. (2012). Collaborative testing improves performance but not content retention in a large-enrollment introductory biology class. Collaborative. *CBE Life Science Education, 11*(4), 392–401.

Ley, K., & Hodges, R., & Young, D. (1995). Partner testing. *Research and Teaching in Developmental Education, 12*(1), 23-30.

Pace, L. (n.d.). Group testing-taking options to consider. [Web Blog Comment]. Retrieved from http://www.facultyfocus.com/articles/teaching-professor-blog/group-testing-taking-options-consider/.

Russo, A. & Warren, S. H. (1999). Collaborative test taking. *College Teaching, 47*(1), 18-20.

Shana (n.d.). Group testing-taking options to consider. [Web Blog Comment]. Retrieved from http://www.facultyfocus.com/articles/teaching-professor-blog/group-testing-taking-options-consider/.

Shea, J. H. (1995). Problems with collaborative learning. *Journal of Geological Education, 43*, 306-308.

Sheridan, J., Byrne, A. C., & Quina, K. (1989). Collaborative learning: Notes from the field. *College Teaching, 37*(2), 49-53.

Srougi, M. C., Miller, H. B., Witherow, D. S., & Carson, S. (2013). Assessment of a novel group-centered

testing scheme in an upper-level undergraduate molecular biotechnology course. *Biochemistry and Molecular Biology Education, (41)*4, 232-241.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Walczyk, J. J., & Ramsey, L. L. (2003). Use of learner-centered instruction in science and mathematics classrooms. *Journal of Research in science Teaching, 40*(6), 566-584.

Weimer, M. (2013). *Learner-centered teaching*. San Francisco, CA: Jossey-Bass.

Weimer, M. (2014, January 15). Group testing-taking options to consider. [Blog Post]. Retrieved from http://www.facultyfocus.com/articles/teaching-professor-blog/group-testing-taking-options-consider/.

Wiggs, C. M. (2011). Collaborative testing: Assessing teamwork and critical thinking behaviors in baccalaureate nursing students. *Nurse Education Today, 31,* 279-282.