

Making Groups Better

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Abstract

How can we best prepare students for careers in our competitive environment? This paper examines how group work or cooperative learning is beneficial in the learning process. It examines certain areas of learning that lend themselves to cooperative learning. Cooperative learning leads to benefits and potential problems in working with groups. We examine ways to prepare successful groups for a project. The paper suggests ways to monitor group work in the classroom. Finally, it reports on a group work study taking place over many semesters in an introductory accounting class. Results include a very successful semester. While subsequent semesters provided good results, results were mixed. What can we do to enhance our students' success in group work projects? The research points to several problem areas that can be addressed. What factors can we consider to improve our results? The research points to ways to prepare students for group work. This paper adds to the research by exploring ways to make group work more successful.

Key Words: Group work, group work issues, group work preparation.

Introduction

Group Work

Group work or cooperative learning has aroused the imaginations of educators as a panacea to elevate learning and enhance the creation of knowledge. It holds the promise to be the one tactic that helps every student reach the class outcomes and learn to work together. Group work also teaches social skills, which are handy in careers after college. However, research is limited on the conditions where it works and where it is not beneficial. The literature is limited in preparing students for group work.

The basic dilemma with cooperative learning involves two issues. Why does it work sometimes and other times create issues? How can we structure the project so that everyone is involved? We are going to examine group based quantitative classes over semesters. This study found group work advantageous in one semester and with limited success in another semester. This suggests many issues. What does the literature suggest regarding strategy in cooperative learning? How do we prepare students for successful learning in groups? What is a successful group? What do we do with unsuccessful groups?

The literature is abundant on successful group work. Much of the literature deals with precollege students. Most of the studies deal with uncontrolled field situations. Springer (1999) finds that uncontrolled field studies gain ecological validity but loose internal validity. He suggests more laboratory-controlled studies to validate the process. Gaps in the literature converge around preparation of groups, types of outcomes best suited to group work, dealing with hesitant group members, encouraging members to participate and measuring outcomes.

Literature Review

Definition

Group work or cooperative learning has been around for a long time. Cohen (2014) defines group work as students working together in a group small enough that every student can participate on an assigned task. It enables students to achieve intellectual and social learning goals. The work consists of talking, listening, asking, reasoning and reaching consensus. Students become the authority and create knowledge based on cooperation. Peters (1998) defines collaborative learning as people laboring together to construct knowledge.

Smith (1996) describes what group work is not. Group work and cooperation is *not* having students sit side-by-side at the same table to talk with one another as they do their assignments. Cooperation is not assigning a report to a group of students, on which one student does all the work and the others list their names. Cooperation is *not* having students do a task individually and then having the ones who finish first help the slower students. Cooperation is much more than being physically near other students, discussing material with other students, helping other students, or sharing material among students, although each of these is important in cooperative learning.

Instead, Smith (1996) implies that to be cooperative a group must have clear, positive interdependence. Members must promote each other's learning and success face-to-face. Students should hold each other personally and individually accountable to do a fair share of the work. They should appropriately use the interpersonal and small-group skills needed for cooperative efforts to be successful. Students should approach the project as a group and effectively work together. These five essential components must be present for small group learning to be truly cooperative. They are positive interdependence, face-to-face interaction, individual accountability, teamwork skills and group processing.

Benefits

There are many reported advantages for group work or cooperative learning. Neville (2018) mentions shared ideas, students working closely together, developing skills, cultivating strengths, dealing with challenges, finding new perspectives, making friends, developing communication skills and active learning skills. Springer (1999) lists the advantages as effective academic achievement, favorable attitudes, persistence, active learning and collaboration.

Researchers seem to flock to group work. There is a substantial body of research supporting group work. Links between cooperative learning theory, research and practice are "one of the greatest success stories in the history of education" (Slavin, 1996). Some meta-analyses support this interest. A meta-analysis of twenty years of students in science classes showed significant gains in classes using group work (Springer, 1999). Another meta-analysis of 390 science studies found significant gains in classes using group work (Shroeder, 2007).

Research shows that collaborative learning can enable students to engage in activities that are valuable for learning (Sweller, 1988). Collaborative learning models show us that certain types of learning happen interactively rather than through a one-way transmission process (Johnson, James, Lye, & McDonald, 2000). Kuh (2008) includes group learning as one of the ten high impact practices necessary

for student learning. Pedagogical research on collaborative learning techniques in education is abundant (Delucchi, 2007; Drouin, 2010; Gorvine & Smith, 2015; Koçak, 2008; Schroeder et al., 2007; Tsay & Brady, 2010; Woodzicka et al., 2015).

Group work and cooperative learning feature the development of soft skills. Because soft skills are critical for productive performance in today's workplace, current and future business leaders are emphasizing the development of soft skills through group learning (Nealy, 2005). Research reports the importance of soft skills in the workplace (Klaus, 2010; Mitchell et al., 2010; Nealy, 2005; Smith, 2007; Weldy, & Icenogel, 1997). One study found that 75% of long-term job success depends on people skills, which group work enhances while only 25% is dependent on technical knowledge (Klaus, 2010).

Some studies list additional gains using group work. Using groups, both cognitive and social adjustment gains can happen (Bruffee, 1978). Triesman (1992) reported significant learning gains from having minority students work together in calculus classes. The shared learning allows students to engage in discussion, take responsibility for their learning, and thus become critical thinkers (Totten, Sills, Digby, & Russ, 1991). Dewey's (1943) experiential philosophy suggested that group work in a nonthreatening environment leads to learning naturally (Springer, 1999). Cognitive theorists (Piaget, 1926; Vygotsky, 1978) suggest that interactions among students increase achievement and facilitate cognitive growth as students learn from each other (Springer, 1999). Terenzini (2001) in a study of engineering students found that group work achieved significant and substantially greater learning.

Group work can address different outcomes. Learning outcomes for collaborative studies fall into three groups. Some outcomes seek analytical processes (Gokhale, 1995; Lazonder, 2005; Woodzicka et al., 2015). Some outcomes reflect attitudes (Drouin, 2010; Koçak, 2008; Stein et al., 1994; Terenzini, 2001; Tsay & Brady, 2010). Some outcomes concern course material retention (Delucchi, 2007; Drouin, 2010; Gorvine & Smith, 2015; Perkins & Saris, 2001; Schroeder et al., 2007; Shibley & Zimmaro, 2002; Smith et al., 1991; Tsay & Brady, 2012). Group work lends itself better to analytical processes and ethical issues than memorization.

Issues

Research on its effects have been promising, but the results are not always positive (Kester & Paas, 2005). Placing learners in groups and assigning tasks does not guarantee they will work together, engage in effective collaborative learning processes, and show positive learning outcomes (Soller, 2001). Springer (1999) points out the classic argument of competition versus cooperation. If our classmate succeeds, he will lesson my grade. Cohen (2014) adds simply that some groups work, some do not work. We live in a social context, experiencing and recalling the milestones and the minutiae of our lives with friends, family, co-workers, and even strangers (Congleton, 2011). Group work highlights this context. Notable gaps in the research base question whether short term uncontrolled experiments should affect practice (Springer, 1999). Motivational theories emphasize the importance of individual responsibility (Springer, 1999). Small groups are not a panacea. Although group work has the potential for supporting learning, talking and working together with peers is the source of a whole series of problems (Cohen, 2014).

Problems can arise in many areas. Neville (2018) states that problems can come from the process or the people. Process problems include lack of ground rules, agenda, roles, leaders, meetings or records.

People problems include members that just do not get along, lack of communication, someone dominating, some people don't speak, people don't listen, people ignoring others, quarreling and angry remarks. Stains (2018) suggests monitoring group size, positive interdependence, criteria of referenced grading, monitoring, time and structure.

Cohen (2014) states that groups activate the status issue where slow or minority students reflect a low status and can be ignored. Students come to class with preconceived notions about each other. Smart students have higher status. Slower students have lower status. Minority students have lower status. Foreign students may have lower status. Status may influence a student participating or speaking. Class games may limit status issues (Cohen, 2014).

Types of Outcomes

Not all learning is the same. Rutherford (2018) mentions multiple studies that point to the advantages of group work in course material retention. However, the outcomes may determine the best use of cooperative learning (Cohen, 2014). Certain outcomes such as memorization may not fit with group work (Cohen, 2014). Some problems require students to recognize a problem and apply a rule. The benefits of group work are more applicable to conceptual problems such as solving a challenging math problem or resolving an ethical dilemma. Group work seems especially useful in areas such as math (Cossey, 1997), science (Bianchini, 1997), and conceptual areas (Durling, 1976). Cohen (2014) suggests matching the pattern of working together with the learning outcomes.

Preparation

There are many ways to prepare students for group work. Peters (1998) suggests that we get students involved early in the semester, point out how group work is similar to student's experience, show everyone respect, display trust in students, help students form relationships within their groups and give everyone in the group equal status. Cohen (2014) has suggestions to limit free riders. Make sure everyone has an individual assignment. Group goals contain individual assignments. Assign routine, well-defined tasks. Monitor performance throughout the semester. Conceptual learning requires the necessary resources, appropriate cognitive and linguistics skills, relevant information, and proper instructions (Cohen, 2014).

Neville (2018) states that successful groups go through a learning sequence displaying acceptance, communication, decisions, productivity and control. He mentions the six hat concept where successful groups display information, intuition, optimism, creativeness and big picture thinking. Smith (1996) finds instructors need to specify the outcomes, make instructional decisions, explain the task, expect positive interdependence, monitor learning, intervene when needed, evaluate learning and help students process.

Several preparatory games help to introduce group work. Games will help to improve communication, define group member roles, encourage ideas and establish trust. Games encourage talking, listening, asking, reasoning and reaching consensus (Cohen, 2014). Shipwreck is such a game. Imagine that your group is on a cruise ship near an island. Your ship is sinking. You can take one item to the island. From a list of eight items, which one should your group take? Cohen (2014) lists over ten other such warm up games. The purpose of the warm up game is to get students in a group used to sharing thoughts, listening, contributing, treating each other with respect and finally arriving at a conclusion.

In general, group work or cooperative learning has many potential benefits and many potential hazards. While most of the literature concentrates on grade school and high school students, some do represent college students. The following study seeks to bring the issues to light.

Method

Accounting Sample

To improve learning in an introductory accounting class, group work was introduced in a Fall 2017 accounting class. Students created groups of four to five people. Students reported a group name and group members. Students were to communicate and work together on weekly projects, compare answers and respond with the best answer. This class was the experimental group because it used group work. Other accounting classes were the control classes. Control classes did not use group work. All classes used the same book, homework, resources and quizzes.

The financial accounting course has many objectives. Students learn accounting concepts and what accounting does. Students learn the language of accounting and the accounting equation. Students learn about assets, liabilities, equity, revenue and expenses. Students learn to construct financial statements including the balance sheet, the income statement, the statement of retained earnings, and the statement of cash flows. Students learn to balance accounts and bank statements. Students learn to diagram accounts such as inventory. Students learn to calculate amounts such a bond interest. Students learn to make decisions based on financial principles. Students learn to measure financial results using ratios.

The work required was conceptual. Each chapter contained a different concept. Accounting also uses specific wording to describe the concepts. Students need to become familiar with the language. Students were required to learn a concept, become familiar with the wording associated with the concept, learn the format of the response and answer questions, create diagrams or solve problems using the concept. For example, students considered the accounting equation, assets equal liabilities plus owners' equity. Students were required to read the concept in the book and follow the examples there. For example, what is the effect on the accounting equation when the business earns revenue? Does the business assets, liabilities or equity increase, decrease or have no change?

Student also had weekly homework and quizzes from the text. Group assignments were required weekly. Several tests were concentrating on application of the concepts. An online project was required. Classes demonstrated the concept, solved problems using the concept, recorded transactions, created schedules and answered questions regarding the concept. Class time was devoted to groups working together on the weekly group assignments.

Accounting classes can be difficult. Accounting is one of the one hundred lowest graded classes. There is a two-course sequence in this topic. The drop, fail, withdraw rate (DFW) at a major Midwest university is over 60% for accounting classes. Accounting classes tend to require a lot of work and a step up in difficulty over freshmen classes. The concepts are difficult to some students. Some students in the class were retaking the class. The instructor explained and demonstrated concepts and procedures in class. Homework, reading materials, videos, Learn Smart publishers video and interactive publisher' slides were available or assigned as well. Tutors were available some of the time. The instructor had daily office hours.

The use of group assignments was to be an aid for students in completing the course. Every chapter has a video, which explained the concept and solved a problem.

The use of groups also gave students another resource to help them learn the material. Students formed their groups. Students picked a leader, a secretary and a name for their group. They were encouraged to share contact information and choose a means to communicate.

The instructions were for each student in the group to submit a solution to the weekly problems to the other members of the group. The groups would choose the best answer and submit it to the instructor. The instructor graded the problem and assigned a grade for the group. Problems were due on Fridays. Group work accounted for 10% of the grade.

Group members also graded each member of the group. In the better groups, this worked well. Students gave realistic grades to each other. In the weaker groups, students tended to assign all the group members high grades whether they deserved them or not.

Our goals were to help an individual students learn the material, alleviate student fears, help students overcome difficulties, encourage attendance, encourage communication, fight discouragement, teach students to work in teams and help students to socialize. To measure the goals, we tracked class quiz scores and DFW (Grades of D, failing grades, and drops) rates. We also surveyed students. All of the accounting sections submitted quiz scores. Some classes used group work, some did not. All of the classes used the same books, ancillary materials, and quiz banks. Instructors used different tests. Instructors usually assigned homework and quizzes from the same materials.

The DFW rates are significant for several reasons. Our campus compares our results to a national average of colleges that admit 75% to 90% of student applicants. Our grade average is 2.43. Our DFW rate is 28%. Our freshman retention rate is 68%. Our eight-year campus graduation rate is 31%. All of these are below the national average for similar schools. National figures suggest that a 1% decrease in our DFW rate will increase our grade point average by 4%, increase our retention rate by 1% and increase our graduation rate by almost 1%. These are significant goals for our students.

Finance Sample

Another professor used small groups in Finance. He divided the class into smaller sections if the sections were too large. The professor assigned students randomly to groups. Projects were assigned to each group. The first group completed the project and explained the result to the other groups. Groups were limited to three students. Groups were assigned at the beginning of the semester. Groups learned together. This keeps them accountable. Individual projects would not have worked as well.

The instructor used this technique in an introduction to finance class (Principles of Financial Management) at a different university in 2017. The process was successful. Students seemed to enjoy getting into their groups. This would typically last for the better part of a 50-minute class period.

During the following fall and spring, group work continued in an introduction to Macroeconomics course and an introduction to Microeconomics course. Both groups of students enjoyed group work. Students requesting more group work in the courses.

In the following semester, the instructor introduced a new method by putting students into small groups and having each group work on a problem set which was due at a later date for homework. The

groups would then take turns explaining one of the problems from the assignment to the rest of the class. This helped keep them accountable and we were able to go around the room and see who was working on the assignment and who needed help. Our feedback suggested the students enjoyed this.

Results

The results were encouraging in the Accounting samples. We examined DFW rates. The DFW rate in the group work class was 20%. The DFW rate in three other classes 37%, 22%, and 28%. The other classes averaged 29%. This was consistent with our hopes. We examined quiz grades. The group work class averaged 74% on their quizzes. The average quiz score in control group classes was 56%. Bases on ANOVA analysis the results were significant ($F(157)= 8.76, p<.01$).

Since this class is considered difficult, we surveyed students to see what they did if they could not solve the problems. We asked their first and second sources of help. The top answer was the text (first place 57%, second place 31%). The second answer was peers or their group (first answer 21%, second place 13%). Some students used Google to solve the problem (first place 18%, second place 25%). Other students used the videos (first place 3%, second place 31%).

Subsequent classes reported DFW rates of 27%, 21%, and 25%. The Fall classes had lower DFW rates. The Spring classes had higher DFW rates. We do not have comparative quiz results from other classes after the Fall of 2017.

The Finance sample did not track DFW rates, quiz or test averages. The main metric used was student satisfaction with the process. Students in this sample enjoyed the group work and asked for more group assignments. Students successfully learned the materials.

Discussion

Reasonable Results

The results suggest that the Fall group work accounting class was successful. Subsequent accounting classes had good results but not as good as the initial course. Students who took the course in the Fall session had better results than students who took the course in the Spring. We looked at the literature to improve our results. These are our recommendations.

First, we need to make sure that we are giving clear directions and demonstrating the concepts in class. Instructors need to be honest and open to student issues. All of the weekly materials including the book the assigned materials, available materials, videos, and notes address the concept and procedures the student needs. The instructor demonstrated the concepts and application and gave students a chance to work together. This was the first collaborative class for many students.

It is important to be familiar with the research on group work and collaborative learning. The research points to ideal group size, group dynamics, and preparation.

Next, we need to look at matching the concepts and application to corresponding problems for the group. The tests cover concepts and applications. We choose problems that covered concepts and applications. The group work needs to lead to the outcomes.

Class games proved to be a good preparation for group work. Performing a class game encouraged class participation and group communication. The results must include responses and agreement from each

group member. This encourages everyone to participate. This also encourages groups to come to reach a consensus. Class games helped limit status issues.

Certain students had issues accessing online materials because of internet issues or just lack of experience with cloud-based assignments. Those students needed extra help with tutors or visits to the instructor's office. Other students seemed to have trouble taking notes. We started posting notes along with the videos.

I had used little preparation in class to get students ready for group work. While groups were encouraged to meet, set up a means of communication and discuss the procedures; there was little work preparation. In the future, groups will perform an in-class prep game to encourage participation and communication. Shipwreck seems appropriate for college students.

Some of the students in certain classes did not do any work and relied on other group members to solve problems for them. Each group member can be given a specific assignment and problems can be split up between the members of the group. Each member can be given a particular part of the problem. Members who slack off are noticed.

Another way to address this issue is to start with a problem that requires the group to answer individually and hand in each student's responses. Students should vote for the best answer if there are differences. This will alleviate the issue of group members covering for each other when they graded each other.

Having students grade each of their members did not always work. The better groups graded their students fairly. The weaker groups did not grade each other as well.

To encourage group members to participate, group assignments start slowly. The first assignment will be an individual assignment turned in by the group. Subsequent assignments are divided by group members. Students who don't answer will receive no credit.

Accounting is a difficult subject. Some students have a difficult time learning the concepts and applying them to solve problems or create schedules. Some students do not have the time to complete the assignments and fall behind. Some students take the time to do the required work but fail to use ancillary materials to help them understand the concepts. Other students just drop out. The purpose of the group work is to give better students a chance to have a deeper understanding of the materials and encourage their study of accounting. The purpose of the group work for average students is to help them to have a better understanding of accounting, get a good grade and understand accounting principles in their careers. The purpose of group work for weaker students is to give them access to another avenue to learn the materials. Hopefully, marginal students will benefit from group work and improve their understanding of the learning objectives.

There are several limiting factors for this study. This study takes place at a high percentage of acceptance, commuter university. Results at other universities and with other demographics of students may vary. We assumed all of the accounting professors are the same. Professors vary. The final grades contained tests. All of the professors used different tests. Some professors used multiple-choice tests, some used application problem tests, and some tests may have been more difficult than other tests. The assumption is that all test was equally difficult. While all of the accounting professors used the same quiz

bank from the same book, not all may have used the same questions or the same degree of difficulty in the questions chosen. Some test applications, some professors use test multiple-choice tests.

Because classes are different, some groups are not as successful as other groups. With better preparation, instructors should achieve better results and consistency. The way we lead students into group work could help us achieve better results.

In general, the use of group work or cooperative learning in this study was beneficial. The DFW rate dropped increasing grades, retention and graduation rates. The quiz scores increased showing better understanding and demonstration of the concepts and problems. Students have another learning resource to help them increase their understanding of the learning objectives. Students learned social skills to help them in their careers. The study also pointed to the literature to improve group work in the future.

Ten Steps to Better Group Outcomes:

Check yourself first, are you open, accessible and familiar with the research.

The concept can be difficult, make sure the task is simple and well defined.

Prepare students with group work in class.

Demonstrate the concepts and application in class.

Make sure students understand the procedure and have all of the necessary resources.

Encourage students to utilize the resources.

Watch for status issues in groups.

Start out requiring individual responses and group agreement.

Provide resources addressing multiple learning styles.

Monitor groups and encourage them.

References

- Bianchini, J. (1997). Where knowledge construction, equality, and context intersect: Student learning of science in small groups. *Journal of Research in Science Teaching*, 34, 1039-1065.
- Bruffee, K. A. (1978). The Brooklyn Plan: Attaining Intellectual Growth through Peer-Group Tutoring. *Liberal Education*, 64(4), 447-68.
- Cohen, E. (2014). *Designing Groupwork: Strategies for the heterogeneous classroom*. (3rd ed.). New York, N.Y.: Teachers College Columbia Un.
- Congleton, A. R., & Rajaram, S. (2011). The influence of learning methods on collaboration: Prior repeated retrieval enhances retrieval organization, abolishes collaborative inhibition, and promotes post-collaborative memory. *Journal of Experimental Psychology: General*, 140(4), 535.
- Cossey, R. (1997). Mathematical computation: Issues of access and equality. Unpublished dissertation, Stanford University, Stanford, CA.
- Delucchi, M. (2007). Assessing the impact of group projects on examination performance in social statistics. *Teaching in Higher Education*, 12, 447-460.
- Dewey, J. (1943). *The school and society* (Rev. ed.). Chicago: University of Chicago Press.

- Drouin, M. A. (2010). The group-based formative summative assessment relates to improved student performance and satisfaction. *Teaching of Psychology*, 37, 114-118.
- Durling, R. & Shick, C. (1976). Conceptual attainment by pairs and individuals as a function of vocalization. *Journal of Educational Psychology*, 68, 83-91.
- Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, Vol. 7 (No. 1), 22-30.
- Gorvine, B. J., & Smith, H. D. (2015). Predicting student success in a psychological statistics course emphasizing collaborative learning. *Teaching of Psychology*, 42, 56-59.
- Johnston, C. G., James, R. H., Lye, J. N., & McDonald, I. M. (2000). An evaluation of collaborative problem solving for learning economics. *The Journal of Economic Education*, 31(1), 13-29.
- Kester, L., & Paas, F. (2005). Instructional interventions to enhance collaboration in powerful learning environments. *Computers in Human Behavior*, 21(4), 689-696.
- Klaus, P. 2010. "Communication Breakdown." *California Job Journal* 28:1-9.
- Koçak, R. (2008). The effects of cooperative learning on psychological and social traits among undergraduate students. *Social Behavior and Personality: an International Journal*, 36, 771-782.
- Kuh, G. D. (2008). Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. *Association of American Colleges and Universities*, 19-34.
- Lazonder, A. W. (2005). Do two heads search better than one? Effects of student collaboration on web search behavior and search outcomes. *British Journal of Educational Technology*, 36, 465-475.
- Mitchell, G. W., L. B. Skinner, and B. J. White. 2010. "Essential Soft Skills for Success in the Twenty-First Century Workforce as Perceived by Business Educators." *The Delta Pi Epsilon Journal* 52(1):43-53.
- Nealy, C. (2005). Integrating soft skills through active learning in the management classroom. *Journal of College Teaching & Learning (TLC)*, 2(4).
- Neville, C. (2018). *Making Groupwork Work*. <http://creativecommons.org/licenses/by-nc-sa/2.0/uk/>.
- Perkins, D. V., & Saris, R. N. (2001). A "jigsaw classroom" technique for undergraduate statistics courses. *Teaching of Psychology*, 28, 111-113.
- Peters, J. M. & Armstrong, J. L. (1998). Collaborative learning: People laboring together to construct knowledge. *New directions for adult and continuing education*, No. 78, Fall 1998, 75-85.
- Piaget, J. (1926). *The language and thought of the child*. New York: Harcourt Brace.
- Rutherford, M. L. & Daniel, F (2018). *Collaborative quizzes: Impact on student performance and attendance*. Unpublished paper.
- Schroeder, C. M., Scott, T. P., Tolson, H., Huang, T., & Lee, Y. (2007). A Meta-Analysis of National Research: Effects of Teaching Strategies on Student Achievement in Science in the United States. *Journal on the Research of Science Teaching*, VOL. 44,(No. 10), 1436-1460.
- Shibley Jr, I. A., & Zimmaro, D. M. (2002). The influence of collaborative learning on student attitudes and performance in an introductory chemistry laboratory. *Journal of Chemical Education*, 79, 745-748.
- Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary educational psychology*, 21(1), 43-69.

- Smith, K. A. (1996). Cooperative Learning: Making groupwork work. *New Directions for Teaching and Learning*, (No, 67), Fall 1996, 71-82.
- Smith, M. E., Hinckley, C. C., & Volk, G. L. (1991). Cooperative learning in the undergraduate laboratory. *Journal of Chemical Education*, 68, 413-415.
- Soller, A. L. (2001). Supporting social interaction in an intelligent collaborative learning system. *International Journal of Artificial Intelligence in Education*, 12, 40-62.
- Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering, and Technology: A Meta-Analysis. *Review of Educational Research*, Vol. 69, No. 1 (Spring, 1999), pp. 21-51.
- Stein, C. H., Cislo, D. A., & Ward, M. (1994). Collaboration in the college classroom: Evaluation of a social network and social skills program for undergraduates and people with serious mental illness. *Psychosocial Rehabilitation Journal*, 18, 13-33.
- Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., ... & Levis-Fitzgerald, M. (2018). Anatomy of STEM teaching in North American universities. *Science*, 359(6383), 1468-1470.
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive science*, 12(2), 257-285.
- Terenzini, P. T., Cabrera, A. F., Colbeck, C. L., Parente, J. M., & Bjorklund, S. A. (2001). Collaborative learning vs. lecture/discussion: Students' reported learning gains. *Journal of Engineering Education*, 90, 123-130.
- Totten, S., Sills, T., Digby, A., & Russ, P. (1991). Collaborative learning: A guide to research. *Scandinavian Journal of Educational Research*, 33(4), 231-243.
- Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *The College Mathematics Journal*, 23(5), 362-372.
- Tsay, M., & Brady, M. (2012). A case study of cooperative learning and communication pedagogy: Does working in teams make a difference? *Journal of the Scholarship of Teaching and Learning*, 10, 78-89.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. (M. Cole et al., Eds.). Cambridge: Harvard University Press.
- Weldy, T. G., & Icenogle, M. L. (1997). A Managerial Perspective: Oral Communication Competency Is Most Important for Business Students in the Workplace Jeanne D. Maes. *The Journal of Business Communication* (1973), 34(1), 67-80.
- Woodzicka, J. A., Ford, T. E., Caudill, A., & Ohanmamooreni, A. (2015). A successful model of collaborative undergraduate research: A multi-faculty, multi-project, multi-institution team approach. *Teaching of Psychology*, 42, 60-63.