# Cooperative Learning Revisited: From an Instructional Method to a Way of Life

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I am delighted and honored to have this opportunity to reflect on cooperative learning, 20 years after publishing an article on this topic in the inaugural issue of JSE (Garfield 1993)**.**  As I re-read the article, I realized that I agree with most of what I originally wrote regarding the use of small groups to help students learn statistics.  However, I also realized that I now understand more deeply the importance and value of collaboration, both in and outside the classroom.

I am proud to have been part of the collaborative team that dreamed up and created the Journal of Statistics Education (JSE).  I am thrilled that after 20 years, JSE is not only an official journal of the ASA, but a well-known, widely recognized, high quality journal that supports the growing community of statistics educators. I applaud the vision of Dan Solomon who initiated the planning meeting in North Carolina, and I am grateful for the dedication and tireless efforts of JSE's inaugural editor, Jackie Dietz, who made  this journal a reality. Today, I feel like a proud parent as I admire the terrific work of my former student and current colleague, Michelle Everson, who currently serves as the editor.

As I look back over 20 years, I see how collaboration has become the cornerstone of my beliefs about teaching and learning and about my own professional development and productivity. While I once viewed cooperative learning as solely a pedagogical method, I now view collaborative learning as my ongoing way of life. It is a defining characteristic of all my work, whether teaching, creating curriculum and assessment, conducting research, and writing.   Not only does collaboration make my work more enjoyable and sociable, it makes me think harder, defend or revise my ideas, and become more creative in brainstorming or problem solving. As a result, collaboration greatly improves the quality of every product I help to create.
Standing firmly on my soapbox, I begin this paper with a brief look backwards at my first exposure to cooperative learning and my early use of this method as a teacher.  Then, I describe my journey as a practitioner of cooperative learning, teaching, and scholarship.

# 1. Early Experiences with Cooperative Learning

The first time I experienced cooperative learning was as a student in a statistics class taken as part of my master's program in Mathematics Education at the University of Minnesota. The students in the class were assigned to work in groups of three. We spent some time in class and also met outside of class to work on homework problems together. This was in 1976, and cooperative learning was just starting to gain attention as an important way to help students learn. Two of the leading advocates of cooperative learning, Roger and David Johnson (brothers) were on the faculty at the University of Minnesota, and taught courses on cooperative learning. Their landmark book (*Learning Together and Alone; Cooperation, Competition, and Indivualization* 1975) was gaining tremendous attention, and they had become the gurus of cooperative learning. Two of my fellow graduate students designed research studies for their dissertations, comparing cooperative learning methods with traditional methods in mathematics classes, and I became more aware of the almost cult-like devotion to these methods sweeping educational communities across the country.

I do not remember when I began to try cooperative groups in my own classes, but I am guessing I began to use group learning activities in the late 1980's, when I was teaching mathematics and statistics in the General College at the University of Minnesota. I remember what it felt like those first few times I summoned up the courage to try something that was very different than giving carefully planned lectures. I wanted to see if having students work together on activities would engage them more than passively listening to me talk, or sitting silently working on a problem in class.

I did a little research to learn how to structure and use cooperative groups, and then decided to give it a try. I walked into class and asked students to form groups of 4. I then asked them to number off in each group from 1 to 4, and assigned each number to a role (moderator, recorder, summarizer, encourager). I handed out copies of an activity, most likely from the newly published *Quantitative Literacy Series* by Dick Scheaffer and colleagues. I told the students they had five minutes to read and work on the problem, asked if there were any procedural questions, and then walked out the door to get a drink of water. Someone had suggested that leaving the room for a few minutes was a good way to get groups going. I walked down the hall with trepidation. What would I face when I returned? Would everyone be sitting in silence, staring at their handouts? Would they resent me for not giving them a lecture?

I walked back into the classroom and was delighted and a little shocked to find the room buzzing with talk about data and graphs and outliers. It was working! I walked around the room listening to students using statistical terms, agreeing or disagreeing on an interpretation, and showing active engagement with the activity. My next challenge was how to get them to stop working together, so we could discuss the activity as a group. I eventually learned some tricks, such as switching the lights off and on or blowing a train whistle.

I was sold. Using cooperative groups became a major part of my classes, and people starting coming to me for advice on how to use group work effectively, I read more of the work by my colleagues David and Roger Johnson, and their collaborator Karl Smith, a professor of Engineering who used this method even with large lecture classes and at professional meetings.

A few years later, I introduced a small group activity as part of a large invited session (called "Statistics, Fin de Siecle") at the Joint Statistics Meetings in San Francisco (1993, just after my article was published in JSE). This session was a panel that had been organized by David Moore and chaired by Dan Solomon. I had suggested that at one point in the panel, we stop talking and invite the attendees in the huge ballroom to stand up, form small groups, and talk to each other about what they considered to be the most important goals of learning statistics. We gave the instructions, guided them to strategically placed index cards to write down their lists of goals, and waited. Some people in the audience headed to the doors. Dan Solomon turned to the panelists and asked "Was this a mistake?" And then the magic began, as people began to talk, with animation, and the room was buzzing with their discussions. We collected the goals they wrote down on the index cards, and these goals were summarized and included in a paper that the panelists wrote together, published in *The American Statistician* (Moore, Cobb, Garfield, and Meeker 1995). I believe this session was more engaging and that participants gained more as a result of their own involvement in thinking about teaching and learning, as a result of the small group activity.

## 2. Growing Interest in Cooperative Learning in Teaching Statistics

Another important event that took place in 1993, in addition to the launching of JSE and the August JSM meetings, was a two-day symposium organized by the Committee on Applied and Theoretical Statistics (CATS) of the National Research Council. The topic was Modern, Interdisciplinary, Undergraduate Statistics Education (MISUE). One topic of the symposium was what we should be teaching, with leading statisticians in academe, business, government and industry sharing their perspectives. While there was much talk about courses and curriculum, what struck me the most were recurrent themes about statistics students needing to be good team workers, good problem solvers, and good communicators. As a discussant for this session, I shared my reaction to these themes by urging statistics educators to give students more opportunities to work together in groups as part of their learning experience, as well as to give students opportunities to write, present, and problem solve (Garfield 1995). I was starting to become familiar with being on a soapbox, and I was enjoying it.

I was delighted to see a growing interest in cooperative learning over the next few years, and began to find articles being published on the use of cooperative learning in statistics classes, such as these which appeared in JSE: Giraud (1997); Keeler and Steinhorst (1995); Magel (1998); and Smith (1998). I continued to use small group activities in my classes, sometimes randomly assigning students to groups, sometimes having students form their own groups. I assigned students to work in groups on a course-long project and was interested to see the friendships that often formed as a result of these group projects.

It seemed that more learning took place as a result of group work because students had to verbalize their understanding, use statistical language, or explain and defend their solutions. My classes became known for my small group activities and projects, and. I received three different teaching awards and was asked to become a mentor to junior faculty on teaching. Much of this mentoring involved helping faculty move away from lectures to try more small group activities. I seemed to have become one of the cooperative learning resource teachers at the university. I

enjoyed working with the junior faculty as they began using this method successfully, even in large lecture classes.

## 3. A Course Based on Small Group Activities: AIMS

In 2005, I received a grant from the National Science Foundation to create an introductory statistics class that was based on small group activities that had been adapted from other projects. It was called Adapting Innovative Materials in Statistics (AIMS). I worked with two of my graduate students and later my colleague, Bob delMas, to create a set of activities and accompanying lesson plans for instructors to use, guiding them in the use of these small group activities as well as large group discussions. We came to realize that many instructors were nervous about moving to a more student-centered approach, where students spent most of the class period working together. In addition to the activities and lesson plans that were posted on a website, I collaborated with Dani Ben-Zvi to summarize the research foundations for the activities and to suggest sequences of activities to develop students' statistical reasoning (Garfield and Ben-Zvi 2008).

We began to give workshops on the AIMS course and approach, and decided that participants needed to work in small groups, so they would experience firsthand the impact of working together, rather than alone, in learning the new curriculum. We realized that many instructors were still reluctant to move to a more activity based, student-centered course, so we made videos to illustrate what a typical class looked like where students were engaged in discussions and group work. We hoped that faculty would find these videos so compelling, compared to students passively sitting in lecture classes, that they would be motived to try the AIMS approach.

Despite our dedication to using small groups, we were also witnessing problems with the AIMS course. Some students seemed to just take a free ride, others didn't show up regularly. Some worried about their grades, others didn't care. We needed some expert help in tweaking our use of cooperative learning methods, and we found it, when Cary Roseth joined our team.

Cary was a doctoral student of David Johnson, and a passionate practitioner of cooperative learning. We hired him to be a teaching assistant for our introductory statistics class that was using the AIMS curriculum. Cary was enthusiastic about our use of small groups, but gave us many tips and practical strategies for improving this method. He also helped us see that groups could be utilized to develop students' statistical reasoning, by having good questions for students to discuss. Cary had read the literature and even conducted a large meta -analysis on cooperative learning research. He liked to use "base groups" to have students check each other on being prepared for class and having completed homework, and then different groups for in-class activities.

## 4. Introducing Cooperative Assessment and Cooperative Teaching

At one of our regular meetings, Cary pointed out that while students were constantly learning together in groups, we were always giving assessments to them to work on by themselves. He recommended the use of cooperative assessments as a way to motivate the students to think harder, and to give them more opportunities to develop and explain their reasoning.  Cary

convinced us, and we began to experiment with in-class group quizzes. The students responded well to these group quizzes, and we liked them too. Along with the benefit of having fewer quizzes to grade, this assessment method seemed to promote more learning as part of the assessment process, due to students having to explain and defend their solutions to each other.

As we worked in a team with Cary, we became committed to the idea of cooperative teaching. We had weekly meetings to discuss activities, homework, and teaching methods. We observed each other teaching the same lessons to learn from each other as well as to identify weak areas in the activities that could be improved. Later, we actually tried co-teaching in the introductory statistics class as well as in our graduate courses in statistics education.  I became more and more convinced that collaboration was as important for teaching as it was for learning. Cary took the lead in writing about both types of collaboration in an article published in JSE in 2008 (Roseth, Garfield, and Ben-Zvi 2008).

After several years of teaching and studying the AIMS course and how students were learning in this course, we became convinced that a different approach to the content, with an emphasis on modeling and simulation, might better prepare students to reason about statistical inference. We felt that much of the curriculum could be removed, as students entered college with a better understanding of basic statistical terms, graphs, and methods. This led to a radically different course, called CATALST.

## 5. Collaborative Curriculum Development and Teaching in the CATALST Project

While I believed that it was important to collaborate in teaching as well as in learning, I became even more convinced about the importance of collaborative teams when we began working on our five-year NSF-funded Change Agents for Teaching and Learning Statistics (CATALST) project.  For this project, we designed, implemented and evaluated a new curriculum for teaching introductory statistics that was highly dependent on small group learning activities. Our team consisted  of three faculty at the University of Minnesota (Bob delMas, Andy Zieffler,  and myself), along with our collaborators Allan Rossman, Beth Chance, John Holcomb and George Cobb, two of our graduate students, Laura  Le and Rebekah Isaak, and our evaluator, Rob Gould. We spent many long hours brainstorming, discussing, arguing, and ultimately, creating the new curriculum. We were excited about the new course and felt it could never have been created without the intense group collaboration.

When we began to teach the CATALST course, we used a co-teaching model, with Andy and Laura together in the classroom, often observed by members of our team.  Class was typically followed by group debriefings and discussions as we made revisions to the activities as well as to the sequence of topics in the curriculum. The co-teaching model worked well as we implemented a radically different curriculum that placed even more demands on the students to work together, learn new software, and become responsible for their own learning.

The following year, we began to work with collaborators to teach the course at other institutions. Drawing on the benefits of co-teaching, we created small teaching clusters of 3 to 5 teachers who met regularly via Skype to provide support needed to make radical changes in their courses. We

felt that these collaborative teaching groups were very effective in troubleshooting and increasing the full implementation of the materials.

We continue to set up weekly meetings of the graduate students who teach our CATALST course, encouraging the model of collaborative teaching by having them discuss assessments, take turns grading, and engage in weekly debriefings as well as planning sessions. Although we call this collaborative teaching, I believe the instructors are learning together to become flexible, expert teachers who can teach innovative curriculum in a student-centered way. Therefore, I view these group meetings as another type of cooperative learning activity.

## 6.  Collaborative Learning in the Online Environment

Recognizing that cooperative learning was a key component of our face-to-face introductory statistics classes, my colleague Michelle Everson took the lead in bringing this type of learning into her online statistics courses.  She developed and taught three courses, creating innovative ways for students to work together, even at a distance (see Everson and Garfield 2008). Michelle also mentored graduate students to learn how to teach this type of student-centered online course.

One of our doctoral students, Audbjorg Bjornsdottir, enjoyed teaching the undergraduate online course and wondered if there was a good way to implement group quizzes in the online environment, especially since we used that method in our face-to-face classes.  After reading the literature and consulting with experts, she designed an experiment to investigate the impact of using collaborative tests on students' learning of statistics, both in terms of the learning outcomes and their attitudes towards statistics. She also explored how using a required consensus vs. a non-consensus approach on collaborative tests affects small group discussions. This research became Audbjorg's dissertation (Bjornsdottir 2012), and she used both qualitative and quantitative data to answer her research questions.  While no significant difference was found between groups using the two collaborative testing formats (consensus and non-consensus), there was a noticeable increase in students' attitudes across both formats towards learning statistics. *Audbjorg found that both methods were feasible to use in an online course and that students reacted positively to group quizzes.*

## 7.  Collaborative Research, Writing, and Scholarship

Collaboration has become an essential part of any research project I undertake.  I continuously marvel at how much I learn by talking, writing, and often arguing with my research partners.

I am fortunate to have wonderful research collaborators over the years, originally Bob delMas, then Beth Chance, and more recently, Andy Zieffler.  Bob, Beth and I wrote about our "collaborative classroom research" for an article in JSE (delMas, Garfield and Chance 1999) and that is still the type of research I prefer to engage in. I cannot imagine being a sole researcher on any project or keeping ideas to myself.  I would much rather walk next door to Bob's or Andy's offices to run these ideas by them and get their input. The resulting project is always improved by our discussions and brainstorming sessions and our long discussions of research findings are also richer than any observations I would have made on my own.

Writing articles, editing books, and designing websites for our project materials are unimaginable tasks without my collaborators. I believe I am a better writer, editor and thinker because of these collaborators. I know I have gained a tremendous amount from my work with colleagues, and that our work is always better than anything I could have produced on my own. We try to promote collaboration among our graduate students, as they begin to work on their own research, and we encourage them to work together as well as with two or three faculty members.

## 8. Collaboration as a Way of Professional Life

As I look back on the past 20 years or more, I see that I used to think cooperative groups were to engage and motivate students, to promote active learning, and to create a vibrant and energetic classroom buzzing with statistical discourse. I now believe that well-designed cooperative learning activities stimulate discovery learning and can build statistical reasoning and thinking.

Good group activities, whether in class or outside of class, or even online, can help students improve their communication skills, their ability to work in teams, and even their success at solving problems: the three desired student outcomes described at the MIUSE conference back in 1993. I have also learned, through many years of experience and observation, what makes a good activity as opposed to an activity where students are asked to work together but do not have a need to work cooperatively to solve a problem. I now am a firm believer in activities that convince students they need to work together because it is too difficult to accomplish a task on their own, something we tried to emphasize in our CATALST project.

Little did I know when I wrote that first article on cooperative learning for JSE in 1993, that I would come to believe that working collaboratively is important not only for students but for teachers and researchers. I am convinced that one reason our statistics education community is such a supportive and positive one is because we are good collaborators. My current collaborators now include eight graduate students in our Statistics Education program, and it makes me proud to see them work together in teaching, in practicing presentations, and in assisting with research. I hope they will carry on this value in their professional work, teaching and scholarship.

As I look forward to the future of Statistics Education, and the move to more online, hybrid, and inverted classes, I am aware of the increasing importance of well-designed collaborative activities for students. I anticipate that my creative and dedicated colleagues in Statistics Education will continue to explore effective uses of cooperative learning in each of these different settings. I hope they will share what they learn with our community by publishing high quality articles in JSE.

## References

Bjornsdottir, A. (2012), "Evaluating the Use of Two Different Models of Collaborative Tests in an Online Introductory Statistics Course," unpublished Ph.D. dissertation, University of Minnesota, Department of Educational Psychology. Available at: http://purl.umn.edu/136255.

delMas, R., Garfield, J., and Chance, B. (1999), "A Model of Classroom Research in Action: Developing Simulation Activities to Improve Students' Statistical Reasoning*," Journal of Statistics Education,* 7. Available at: http://www.amstat.org/publications/jse/secure/v7n3/delmas.cfm.

Everson, M. G., and Garfield, J. (2008), "An Innovative Approach to Teaching Online Statistics Courses," *Technology Innovations in Statistics Education*, 2. Available at: http://repositories.cdlib.org/uclastat/cts/tise/vol2/iss1/art3/

Garfield, J. (1993), "Teaching Statistics Using Small-group Cooperative Learning," *Journal of Statistical Education*, 1. Available at: http://www.amstat.org/publications/jse/v1n1/garfield.html.

Garfield, J. (1995), "Respondent: 'How should we be teaching statistics?'" *The American Statistician,* 49, 18-20.

Garfield, J., and Ben-Zvi, D. (2008), *Developing Students' Statistical Reasoning: Connecting Research and Teaching Practice*. Netherlands: Springer.

Giraud, G. (1997), "Cooperative Learning and Statistics Instruction," *Journal of Statistics Education,* 5. Available at: http://www.amstat.org/publications/jse/v5n3/giraud.html.

Keeler, C. M., and Steinhorst, R. K. (1995), "Using Small Groups to Promote Active Learning in the Introductory Statistics Course: A Report from the Field," *Journal of Statistics Education*, 3. Available at: http://www.amstat.org/publications/jse/v3n2/keeler.html.

Magel, R. C. (1998), "Using Cooperative Learning in a Large Introductory Statistics Class, " *Journal of Statistics Education*, 6. Available at: http://www.amstat.org/publications/jse/v6n3/magel.html.

Moore, D., Cobb, G., Garfield, J., and Meeker, W. (1995), "Statistics Education, Fin de Siècle," *The American Statistician*, *49*, 250-260.

Roseth, C.J., Garfield, J.B., and Ben-Zvi, D. (2008), "Collaboration in Learning and Teaching Statistics," *Journal of Statistics Education,* 16. Available at: www.amstat.org/publications/jse/v16n1/roseth.html.

Smith, G. (1998), "Learning Statistics by Doing Statistics," Journal of Statistics Education, 6. Available at: http://www.amstat.org/publications/jse/v6n3/smith.html.

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