Laboratory Learning in a Research Methods Course: Successes and Challenges

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Abstract
Laboratory-based learning is increasingly considered to be an integral component of undergraduate education. However, students do not always perceive the value of laboratory learning in the college classroom. The current research sought to create an effective laboratory learning environment within a research methods course and to assess students’ perceptions of this approach at the end of one semester. This article reports the findings for two studies; in Study 1, a survey was given to 17 criminal justice, health care management and advocacy, and psychology students. In a subsequent semester, challenges from Study 1 were addressed, and the same survey (i.e., Study 2) was given to 20 criminal justice and psychology majors. Across both samples, students’ responses to the laboratory learning paradigm were generally positive, yet concerns and challenges were identified. Future research should attempt to address these concerns and to assess objective student outcomes, such as grades in the course.

Keywords
laboratory learning, cooperative learning, problem-based activities, undergraduate education, research methods

A substantial amount of research has provided support for improving learning outcomes by engaging students in hands-on, laboratory-based activities within the college classroom. Instructors can create a community of active, rather than passive, learners through techniques such as problem-based group activities (Drouin, 2010; Kreiner, 2009; Williams, 2007), service learning (Connor-Greene, 2002), student-led discussion groups (White, 1978), and cooperative learning (Carlsmith & Cooper, 2002; Thompson, Vermette, & Wisniewski, 2004). However, incorporating these techniques into the classroom comes with its challenges; for example, it is often challenging to convince students to embrace cooperative learning or, as they are used to calling it, “group work.” As Giordano and Yost Hammer (1999) posit, it is wise to anticipate that students are going to be resistant to “group work.” Therefore, cooperative learning depends on the ability of the instructor to convey the value of working with their peers and to effectively facilitate group projects.

Diane Halpern’s guidelines for cooperative learning can be used to anticipate, and address, issues of students’ perceptions of working in groups, and set up an environment that will encourage cooperative, problem-based learning (Halpern, 2011). These guidelines include making sure that there are never more than four students in a group and that students are strategically assigned to groups. Halpern also encourages a degree of positive interdependence, while also incorporating methods of keeping individual group members accountable for their contributions. In this model, the role of the professor is to act as a facilitator, someone who can resolve conflict within groups, and ensure that the problem-solving discussions are interactive and inclusive of all students (Halpern, 2011).

Today, many colleges are revising their curriculum to follow a laboratory learning model, which creates laboratories inside and outside of the classroom, and often depend on cooperative learning-based projects. Experts in the field of education describe this model as providing, “alternatives to lectures and ‘recitation’; they are a clarion call for hands-on learning and social interaction among students with each other and collectively amongst faculty, staff and students” (DeCiccio, 2009, p. 79). However, it is also acknowledged that there are challenges to the laboratory-based model such as getting undergraduate students to appreciate the value of laboratory activities within a research methods course (Strategies for Success, 1999), particularly when they are more familiar with the traditional lecture-based approach.

According to Lewandowski and Sizemore (2011), research methods courses present unique challenges in terms

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of students’ perceptions and attitudes; among these challenges are that while students may be “learning,” they may not be “liking” the course because they see research methods as one of those courses that you just have to get through to graduate. Furthermore, although students seem to understand the utility of biological research, this may not extend to social research. Finally, because statistics, research methods, and writing courses are often taught separately, students may not be integrating their knowledge of all three together (Lewandowski & Sizemore, 2011). Dr. Lewandowski’s excellent mentorship contributed greatly to this project.

The rationale of the following two studies was to design, and improve upon, a research methods course that would reflect the need to integrate statistics, methodology, and writing (Lewandowski & Sizemore, 2011) using a laboratory learning approach (DeCiccio, 2009) and guidelines for setting up an effective cooperative learning environment (Halpern, 2011). The major goals were to foster students’ perceptions of the value of laboratory learning, to instill an appreciation of research methods in the social sciences, and to improve student learning outcomes through cooperative learning projects with their peers. The successes and challenges of this approach are reported, and future directions identified.

**Study 1**

The goal of Study 1 was to create an environment that would promote laboratory learning throughout one semester of an undergraduate social research course. As this type of curriculum continues to be emphasized in higher education, it is important that best practices in delivering such a curriculum be identified and embraced by students. Furthermore, celebrating successes and responding to challenges in an attempt to grow as teachers and as learners will lead to a more successful and knowledgeable community in institutions of higher education.

**Method**

**Participants.** Participants in Study 1 were 17 undergraduate students (65% female) between 20 and 35 years of age ($M = 22$ years). These students were enrolled in a research methods course at a 4-year liberal arts institution that is required for all psychology, health care management and advocacy, and criminal justice majors. In Study 1, 10 of these students were psychology majors, four were majoring in criminal justice, and three students were health care management and advocacy majors. When asked about their status at the college, eight of them reported that they were seniors, graduating the following semester, eight of them were juniors at the college, and only one student was a sophomore. Finally, 80% of the participants had plans to attend graduate school at some point in their future. This was a convenience sample; the purpose of the survey was described to all students in the class, and on the day of the final exam, the students were given the opportunity to complete the survey for extra credit on the final. They were also told that if they chose not to complete the survey, they could sit quietly at their desks, and request an alternative extra credit assignment after class was over. The completed (or uncompleted) consent forms served as the method of assigning extra credit, or alternative extra credit assignments. On the day of the final exam, 100% of students in the course provided informed consent to participate in a survey on cooperative and laboratory learning and received bonus points on their final exam.

**Materials.** The first set of Likert-type scale questions on the survey, which addressed students’ perceptions of the effectiveness of laboratory learning, were adapted from Drouin’s (2010) Formative Summative Assessment (FSA); participants were instructed to rate their responses on a scale of 1 (strongly disagree) to 5 (strongly agree) to such items as “The laboratory projects were a good way to practice key concepts that we were learning in class.” The second set of Likert-type scale questions on the survey, which addressed students’ perceptions of the effectiveness of cooperative learning, were adapted from a course evaluation survey developed by Thompson et al. (2004); participants were instructed to rate their responses on a scale of 1 (strongly disagree) to 5 (strongly agree) to items such as “every person in the group had an opportunity to share his or her ideas.” Finally, based on a qualitative summary developed by Carlsmith and Cooper (2002), students were asked to describe their thoughts, feelings, and/or observations about at least three positive and three negative aspects of working in small groups on the laboratory projects.

**Design.** The data for this study were collected using a survey containing 14 questions that took approximately 10 to 15 min for each student to complete. Twelve questions were Likert-type, close-ended scale questions, and the last two questions on the survey were open ended. After the data were collected, it was entered into Microsoft Excel, and the frequencies and means were calculated for each scale question. The open-ended questions were organized into themes that followed the Halpern (2011) guidelines for cooperative learning, which were used to structure the course.

**Procedure.** A course in social research cross-listed in the criminal justice, health care management and advocacy, and psychology majors was organized around the concept of laboratory learning during a fall semester. The class met on Mondays, Wednesdays, and Fridays with an extra session on Wednesday afternoons for 14 weeks during which students completed eight laboratory projects in small groups throughout the semester. At the end of the course, students were given an opportunity to participate in an institutional review board (IRB)-approved survey that elicited their feedback about these laboratory sessions.
The course was structured so that students knew what to expect each week. Monday and Wednesday mornings (Session I) were focused on discussing content and theory, including what they had learned from their reading for that week. Wednesday afternoon (Session II) consisted of problem-based laboratory assignments. Students were randomized into groups, ensuring that group membership was different each week and students were able to work with each one of their peers at least once. Students completed their laboratory reports and forms rating each group member’s contribution (including their own), and submitted one laboratory report as a group. On Friday, laboratory reports were handed back and discussed, with the professor identifying any remaining issues with the material. In terms of the negative comments, students reported that they learned more because they had the opportunity to explain things to their peers (M = 4.00), and felt that they completed the labs more successfully together than they would have on their own (M = 3.65; see Figure 2).

Results and Discussion

Overall, results showed that on an FSA, a 5-point Likert-type scale created by Drouin (2010), students enjoyed the structure of the labs (M = 3.75), found the labs useful (M = 4.10), and especially liked that the labs gave them an opportunity to practice and apply key concepts they were learning in the class (M = 4.25; see Figure 1). On a 5-point Likert-type scale assessing their perceptions of cooperative learning (Thompson et al., 2004), students reported that they learned more because they had the opportunity to explain things to their peers (M = 4.00), and felt that they completed the labs more successfully together than they would have on their own (M = 3.65; see Figure 2).

The positive and negative comments provided by students could easily be organized according to the guidelines set forth by Diane Halpern and used to design this course (see Table 2). Their positive comments showed that students who would normally be too shy to participate were given the opportunity to share their opinions and thoughts about the course material. They also appreciated the opportunity to get acquainted with, and learn from, their classmates. Finally, they felt that the laboratory projects allowed them to apply the information they were learning in class, leading to a better understanding of the material. In terms of the negative comments, students reported that it was sometimes difficult to include everyone in the conversation, and some of the laboratory project goals or instructions were unclear. However, most of the negative comments were related to individual accountability and conflict among

| Lab title                                      | Problem                                                                 |
|-----------------------------------------------|-------------------------------------------------------------------------|
| Lab 1: Science vs. pseudoscience              | Use seven characteristics of pseudoscience to determine which characteristics are used by advertisements in the media. |
| Lab 2: Working with variables                 | Determine whether a series of hypotheses should be tested with experimental or non-experimental methods, identify independent and dependent variables, and provide operational definitions. |
| Lab 3: Ethics and the IRB                     | Each group is given a proposed study and asked to evaluate the proposal based on the principles of the Belmont Report (1979) and to complete an informed consent form for that proposed study. |
| Lab 4: Library research                       | Group members choose a research question and use electronic resources through the library to find articles on that question. Then, they identify their keywords, and summarize their findings. |
| Lab 5: Naturalistic observation               | Each group proposes a study that will use naturalistic observation; when the proposal is approved by the professor, they complete observations, and together come up with three themes that emerged from their field notes. This is a two-part lab (taking place over 2 weeks). |
| Lab 6: Survey research                        | The class came up with a survey topic, and each group contributed a section of the survey (five questions total). Once the entire survey was compiled (by the professor or course apprentice), students collected the data, entered it into Excel, and analyzed a correlation between one of their variables and a variable from another group. In Study 2, students completed individual lab reports. |
| Lab 7: Experimental research                  | The professor (or course apprentice) set up cups filled with different brands of soda. The students blindly tasted each brand and answered a series of survey questions. This was a within-subjects experiment. Once the survey responses were compiled by the professor, each group was given one variable on which to perform an analysis of variance. In Study 2, students completed individual lab reports. (Note: this is a twist on the original Pepsi Challenge in 1975; Bhasin, 2011). |
| Lab 8: Final project                          | In Study 1, each student completed an article analysis. In Study 2, students chose their own group members and completed a research project. |

Note. IRB = institutional review board.
group members; students felt that not all group members contributed equally and individual grades did not necessarily reflect that. Also, disagreement among group members was difficult to solve due to conflicting personalities and level of effort. Finally, there were no comments, positive or negative, in terms of perceptions of the teacher as a facilitator, or coach, in the classroom.

Overall, the data show that students embraced the laboratory projects throughout this course. The structure of the laboratory projects learned better understanding of course material, relationships with classmates, and opportunities to participate in class. However, there were also clear challenges reported in the open-ended positive and negative comments, in particular, the occasional lack of participation from peers, questionable fairness of individual accountability, and conflict among group members.

**Study 2**

The goal of Study 2 was to address the issues raised by students’ open-ended responses from Study 1 in a subsequent semester, keeping as many other elements of the original course structure, as well as the survey given at the end, as consistent with Study 1 as possible. A few important changes were made in the structure of the course in an attempt to improve students’ perceptions of laboratory learning in research methods. Such changes included increasing the individual accountability of each member in the small groups, adding a course apprentice as another source of support to students in the class, clarifying the instructions and goals of the laboratory assignments, without changing the content of each lab from one semester to the next, and finally adding a more substantial final project that would allow students to choose their own groups and end the course on a positive lesson in cooperative learning.

**Method**

**Participants.** Twenty undergraduate students (47% female) in a social research course at a 4-year liberal arts college between 20 and 36 years of age ($M = 22$ years) completed this study. These students were enrolled in a research methods course at a 4-year liberal arts institution that is required for all psychology, health care management and advocacy, and criminal justice majors. In Study 2, 12 of these students were psychology majors and eight were majoring in criminal justice. There were no health care management and advocacy students. When asked about their status at the college, 13 of them reported that they were seniors, graduating the following semester; five of them were juniors at the college; and two students were sophomores. Finally, 62% of the participants had plans to attend graduate school at some point in their future. The sampling was identical to Study 1. This was, once again, a convenience sample. After the purpose of the study was described to all students, they were given the opportunity to complete the survey, or an alternative assignment, to count as extra credit toward the final exam grade. Eighty-one percent of the students in the course elected to complete the survey.

**Materials.** The materials used in Study 2 were exactly the same as those in Study 1. The survey contained seven Likert-type questions adapted from Drouin’s (2010) FSA and five
Likert-type questions adapted from a course evaluation survey developed by Thompson et al. (2004). Finally, students were asked to describe at least three positive and three negative aspects of working in small groups on the laboratory projects (Carlsmith & Cooper, 2002).

**Design.** The design for Study 2 was also identical to the design for Study 1; the same study materials were used with no differences or changes made. These materials included a 14-question survey that took students approximately 10 to 15 min to complete. Again, 12 questions were Likert-type, close-ended scale questions, analyzed in Microsoft Excel, and the last two open-ended questions on the survey were organized into themes that followed the Halpern (2011) guidelines for cooperative learning.

**Procedure.** As aforementioned, the goal of this study was to improve the course, focusing on issues raised by students in Study 1 while keeping all other elements consistent. Both courses were taught on Mondays, Wednesdays, and Fridays during the fall semester; were of a similar size; and consisted of criminal justice, health care management and advocacy, and psychology majors. The lab assignments were very similar throughout the semester, as was the general structure of the course, and the same textbook was used for both courses. Once again, Diane Halpern’s guidelines for cooperative learning were followed to anticipate issues and set up an environment that would encourage an understanding and acceptance of laboratory learning.

A few changes were made to the course to address the issues raised in Study 1. At the conclusion of Study 1, students’ negative perceptions of the laboratory-based approach to the research methods course rested mostly in the area of individual accountability; they felt that individual grades were unfair, and that some group members did not participate or contribute to the group in a meaningful way. As aforementioned, improving the perception of cooperative learning among students is a major goal of this research. Therefore, at the beginning of the next semester, the instructor spent a significant amount of time emphasizing the value of cooperative learning in a research methods course. A section on cooperative learning was included in the syllabus, and most of the first class meeting of the semester was spent allowing students to create their own cooperative learning contract. Each week, every member of every group received the contract, read it, and signed it, agreeing to abide by its guidelines or receive a penalty in their grade. Finally, students completed individual lab reports for the three major lab projects (naturalistic observation, survey, and experimental design) and were allowed to choose their own group for the final project based on their success (or failures) with the groups they had formed during the semester.

Another area of concern from Study 1 was that there were no comments, positive or negative, in terms of perceptions of the teacher as a facilitator, or coach, in the classroom. To improve the perceptions of educator as facilitator, an upper-classman who had performed very well in the course was made a course apprentice as part of our Course Apprentice Program (CAP). This way, there would be more than one leader in the classroom to facilitate learning and to support the students both individually and in their groups.

Furthermore, there was some confusion about the instructions and overall goals for some of the laboratory assignments, which may have led to some disagreements or ineffective discussion among group members. To remedy this, minor clarifications were made in the laboratory assignments based on the previous semesters’ suggestions. However, the content of the laboratory assignments was not changed. For example, in Lab 2: Working with variables, the instructor originally presented the students with two variables and instructed them to write a hypothesis, decide whether the method used to test the hypothesis should be experimental or non-experimental, identify the independent and dependent variables, and operationalize each variable. This turned out to be too advanced for the students in week 2 of the course, and different groups came up with different scenarios, so the answers were not standardized. Therefore, in the subsequent semester, the same research questions and variables were presented to students, but the hypothesis statement was already written out for them. That way, all students were working from identical hypotheses, rather than some groups using one variable as the independent variable, and other groups using that same variable as the dependent variable. They were then asked, from that hypothesis, to identify the appropriate method, and the independent and dependent variables, and operationalize them.

Finally, it seemed inconsistent to the goals of the course to make the final project an individual article analysis when the rest of the laboratory projects had been completed in groups. Therefore, in Study 2, the final project was a study designed, conducted, analyzed, and presented in groups formed by the students based on their previous experience with students in the class. This allowed the course to end on a positive note in terms of the amount of work that can be accomplished when cooperative learning is involved.

**Results and Discussion**

Once again, results showed that students embraced laboratory learning in the classroom. Responses on the FSA were very similar between Studies 1 and 2. Students enjoyed the structure of the labs ($M = 3.71$ in Study 2, $M = 3.75$ in Study 1), found the labs useful ($M = 3.94$ in Study 2, $M = 4.10$ in Study 1), and especially liked that the labs gave them an opportunity to practice and apply key concepts they were learning in the class ($M = 4.06$ in Study 2, $M = 4.25$ in Study 1; see Figure 3). Although the responses on the FSA were very similar between Studies 1 and 2, agreement with two of the statements on the perceptions of cooperative learning scale was markedly higher. In Study 2, students
agreed more with the statements that every person in their
groups had the opportunity to share their ideas (M = 4.18 in
Study 2, M = 3.60 in Study 1), and that they encouraged each
other to contribute ideas within the group (M = 4.24 in Study
2, M = 3.25 in Study 1; see Figure 4). This may be explained
by the changes that were made in the course between Study
1 and Study 2, most importantly the addition of a course
apprentice to provide support for the students, the creation
of a cooperative learning contract signed by all the students
in the class, and the fact that students were allowed to choose
their own group for the final project.

Finally, the positive and negative comments provided by
students were once again consistent with the guidelines used
to organize the course (see Table 3). However, the comments
from Study 2 were much more multifaceted, and there were
more positive comments than in Study 1. Once again, stu-
dents felt that working together on hands-on projects lead to
a better understanding of course material, and they appreciated
the opportunity to feel closer to, and learn from their class-
mates. However, they also reported that sharing the workload
helped them to finish the assignments faster and more accu-
rately, the new cooperative learning contracts increased indi-
vidual efforts (but could be enforced more), and the structure
of the class allowed students to improve their communication
and teamwork skills. Also, including the course apprentice in
the class seemed to have led to an understanding of the teacher
as a facilitator in the classroom. The course apprentice was
seen as being available to answer questions when the teacher
was not, and peers were able to provide feedback when the
teacher was unavailable or unclear.

In terms of negative comments, students reported that
sometimes they were distracted or went off-topic in their
group discussions, and it was difficult to work with students
outside of class (on their final project) due to their busy sched-
ules and failure to communicate. Similar to Study 1, students
also reported that on some weeks (i.e., in certain groups) some
students did not participate as much as others, and that because
the groups were always different, some personality types con-
flicted and it was difficult to settle arguments.

Overall, the data from Study 2 showed similar results to
Study 1, with obvious improvement on perceptions of labo-
ryatory learning, and positive comments. However, there were
also the challenges presented by the occasional lack of par-
ticipation from peers and conflict among group members
persisted.

Table 3. Positive (+) and Negative (−) Open-Ended Responses
in Study 2.

| Positive interdependence                                      |
|--------------------------------------------------------------|
| + Working together allowed for more hands-on learning and better understanding of concepts |
| + Sharing the workload led to faster and more accurate results on the labs |
| − With less structure, there were more opportunities for people to get distracted or off-topic |

| Individual accountability                                    |
|--------------------------------------------------------------|
| ± Cooperative learning contracts increased effort in groups but should be enforced more |
| − There was a lack of participation among some group members (on some weeks) |

| Appropriate assignment to groups                              |
|--------------------------------------------------------------|
| + Opportunity to become closer to classmates, meet new people, and make new friends |
| − Groups were always different; some groups worked better than others |

| Teacher as facilitator                                       |
|--------------------------------------------------------------|
| + When the teacher was not available, the course apprentice (CAP) could answer questions |
| + Peers explain things in a way that is different, and sometimes more clear, than the teacher |
| + Peers provided immediate feedback when the teacher was unavailable |

| Attention to social skills                                    |
|--------------------------------------------------------------|
| + The structure of the class allowed students to work on communication and teamwork skills |
| − There were sometimes personality differences among group members that caused arguments |
| − It was difficult to work with group members outside of class (e.g., conflicting schedules) |

| Interactive problem solving and discussion                     |
|--------------------------------------------------------------|
| + Applying the information through the labs led to a better understanding of course material |
| + Discussing with peers provided different perspectives, and others to “bounce ideas off of” |
Summary and Concluding Discussion

Students in Study 1 and Study 2 seemed to appreciate the cooperative, problem-based, laboratory learning approach to research methods. Participants seemed to realize both the social and educational benefits of working with their peers on difficult concepts within the course. However, the changes implemented in Study 2 (e.g., the addition of a course apprentice, the emphasis on the importance of cooperative learning, and the revision of laboratory projects to increase individual accountability) improved students’ perceptions in a few important ways. First, students reported feeling slightly closer to their classmates, had a little more enjoyment when working with their peers, and more desire to complete laboratory projects in other courses (see Figure 5). Second, every mean on the perceptions measure was higher, except for one; students did not report a better understanding of the material in Study 2 (see Figure 6). Perhaps the most striking improvement occurred in the open-ended responses. Overall, responses were much more positive, and multifaceted. This might be an indication that students recognized and appreciated more specific elements of the course than in Study 1. It may also indicate, however, that the laboratory learning model adopted across the curriculum of the entire college is also being viewed more favorably.

This study had a few strengths. First, in both studies, a high percentage of students in the class agreed to participate (100% in Study 1 and 81% in Study 2), and I have every reason to believe that their responses were open and honest. Also, a majority of the students in each study had plans to attend graduate school (80% in Study 1 and 62% in Study 2), so the success of this course was extremely relevant to this population. Furthermore, the idea for this project came from a student who had taken the class, and was able to communicate her concerns, and those of her classmates, from firsthand experience. Her contributions were, and continue to be, essential for the success of this project. Finally, using Halpern’s (2011) guidelines for creating an effective cooperative learning environment provided an excellent framework that was useful in setting up, maintaining, and evaluating this classroom environment.

This study also had a few limitations. First, the results of these studies are based completely on the subjective accounts of students in the class. Future studies should collect objective data such as the effect on exams or overall grades when working in groups versus working individually. Second, in both studies, students were given the option to receive extra credit in return for their participation. This may have affected their decision to participate, and could have biased their answers to the survey. Finally, occasional lack of participation from peers and the conflict that may result from this dynamic remain to be examined. It might have been useful to ask for further elaboration on this, or suggestions for improvement, to discern whether these were concerns specific to this course or whether the bias toward individual work over group work continued to persist.

The results of this study showed that a laboratory learning environment using cooperative, problem-based laboratory techniques to teach an undergraduate social research course across majors can be successful. Overall, students benefitted from the opportunity to learn from, and to teach their peers. They also felt more comfortable contributing in small groups than speaking up in front of the entire class, and applying the concepts they were learning in class made them feel more competent with the course material. However, challenges remain. Groups continue to experience and struggle with social loafing and conflicting personalities among group members, even when students are randomly assigned to a new group for each project. Further research should explore how to form groups that will work well together and resolve conflict effectively, and to investigate whether these changes can improve objective goals in the course, such as an increase in students’ grades.

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