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Experiencing the Research Process in a Single Class Period

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Abstract

Books and courses on research methods, statistics, or both, often necessarily focus on one topic at a time. This compartmentalized approach prevents students from seeing the big picture. To address this shortcoming, I developed an exercise through which students experience the whole research process in a single class period. From posing a question, through devising a method, collecting and analyzing data, to writing the report, students conduct all aspects of a basic research project. After the experience, students reported a significant increase in their understanding of the research process. In addition, students recommended using the exercise in future classes and at other universities. I end by discussing various ways that the exercise can be adapted to other class situations and content areas.

Keywords: Scientific method, research process, statistics.

Tell me and I'll forget. Show me and I might remember. Involve me and I'll understand. – Unknown

The chapters in most texts, whether books on research methods, statistics, or both, focus on one topic at a time. A typical introductory research methods book has chapters on descriptive methods, experimental methods, ethics and single case and quasi-experimental designs (Shaughnessy, Zechmeister, & Zechmeister, 1999). A typical introductory statistics text covers such topics as central tendencies, variability, z scores, probability, sampling distributions and hypothesis testing, and various parametric and nonparametric statistics (Gravetter & Wallnau, 2004). Introductory statistics texts seldom show how a statistic is prescribed by the methods chosen, and introductory methods books rarely show how methods limit the statistics used. Although combined research methods and statistics books do some integration of methods and statistics topics, such books are typically divided into large methods and statistics sections (e.g., Heiman, 2001).

The compartmentalized approach is maintained as teachers' curricula often mirror that of the textbooks they use. Indeed, one could argue that the novelty and the difficulty of methods and statistics concepts require addressing the topics one by one. Add students' anxiety about statistics and methods to the newness of the topics (Onwuegbuzie, 2004), and this segmented approach seems logical, if not necessary.

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The downside of this approach is that students often fail to see the big picture. Although they may understand the different aspects of the research process, they do not always understand how these seemingly disparate pieces fit together. Thus, one of the many difficulties in teaching statistics and research methods is helping students appreciate how statistics and research methods connect within the research process as a whole.

Another difficulty is actively engaging students in statistics and methods. We know that students benefit from active learning (Chickering & Gamson, 1987) and that they prefer it (Bonwell & Eison, 1991). Furthermore, teachers acknowledge that actually conducting research is essential to students' understanding of statistics and research methods (Smith, 1998; Snee, 1993; Yoder, 1979). The exercise I present actively engages students in research by having them conduct it. Through the exercise, students experience the research process from start to finish in a single class period, and thereby experience the big picture.

In addition to providing a global view of the research process, the exercise meets two other objectives. One is the opportunity to experience and solve the problems that a researcher encounters while engaged in research (Smith, 1998). Introductory textbook descriptions of research and teachers' examples do not always convey the mundane difficulties one experiences in devising and conducting research. However, experienced researchers know that problems such as sampling errors or missing data are part of the research enterprise and that mistakes such as poorly operationalizing variables or collecting unusable data are common for beginning researchers. In their first efforts, students inevitably make mistakes that they must try to rectify (Felder & Brent, 2003). By encountering and overcoming obstacles in the research process, students actively learn lessons, and lessons actively learned are lessons remembered (Chickering & Gamson, 1987; Keeler & Steinhorst, 1995).

The other objective of the exercise is to develop the seeds of mastery. Because students have learned about research without doing it, they have no reason to feel efficacious -- to believe that they, too, can be researchers. Many approach their statistics and methods courses with trepidation that lingers (Onwuegbuzie, 2000, 2004). Even those who become confident in their understanding of the individual concepts may think themselves incapable of successfully engaging in the entire enterprise. This exercise provides an opportunity for success. Students and their classmates experience all the basic steps of a research project, and in so doing, discover that they all can be researchers.

Method

I taught a research methods course that was the second quarter of a two-quarter statistics and methods sequence. Although students had exposure to statistics and pieces of the research process, they had not yet put the pieces together. To address this shortcoming, I developed an exercise that gave students the opportunity to experience the entire research process in a single period. I conducted the exercise on the first day of the research methods course.

Procedure

I randomly assigned students to work in groups of three. Randomly assigning students provided the opportunity to review random assignment (vis-à-vis random sampling), and prevented self-selection into groups of distinctly different ability levels (see Cumming, 1983). Though students often have mixed feelings about group work, I emphasized that the research process is almost always collaborative.

Each group developed three testable research questions, with the ultimate goal of choosing one as the question that they would answer. The criterion for the questions was simple: Students were to ask questions for which they could collect empirical data on or around campus in the next hour. They were to state their chosen question clearly in a sentence. If the question implied a relation among variables, then they were to state the question in the If: Then: Than format of a hypothesis. One such question was, “If people enter the east door of the student union, then they will be more likely to buy a coffee than people who enter through the west door.” Some other questions were as follows: “If people grew up in a metro area, then their political views will be more liberal than those of people who grew up in rural areas.” “Most people know someone who has been diagnosed with depression.” Students in my course had all had introductory psychology where they learned the scientific method. Most also had had one or more content courses (e.g., abnormal, developmental, social) and knowing the content helped them come up with psychological, interesting questions. However, the hypotheses did not necessarily have to relate to psychology per se. Another example question was, “How many buildings are there on campus?” At first blush, a question about buildings seems absurdly simple, but many methodological issues arose when answering it (e.g., operational definitions of “building” and “on campus”).

Students had approximately 8 min to develop their potential questions (Step 1). The time allocations are suggestions, and are laid out in Table 1. With the exceptions of bringing students together for step 2 and the final discussion, students typically worked through the steps at their own pace, spending more time than suggested on some steps and less on others.

After time had elapsed, students met as a class, and each group proposed one of their three hypotheses (Step 2, 15 min). The entire class critiqued the hypotheses and made suggestions for improvement. Often these criticisms and suggestions concerned practicalities: How was the group defining the variables? How were they going to gather and track their information? When their favored question provided too many stumbling blocks, groups turned to one of their other questions. I facilitated the discussion but provided little direction, letting students supply the feedback, and letting each group settle on the single question they wished to answer. Although potential problems were evident (e.g., inclusion of a hard-to-define variable), I chose to let students proceed and discover their problems and solutions through the process. In classes where students are not yet familiar with research ethics, the teacher may have to guide question selection more.

Table 1. Steps in the Research Exercise

Step	Activity	Time Allowed
Step 1	Question development	8 min
Step 2	Hypothesis selection	15 min
Step 3	Operationalize variables	5 min
Step 4	Method development	5 min
Step 5	Data collection	20 min
Step 6	Data entry and analysis	10 min
Step 7	Results interpretation	10 min
Step 8	Preparation of brief report	10 min
Step 9	Sharing with the class	20 min

Note. The activities and times indicated are suggestions. The instructor may modify the steps and time allotments as they choose.

After selecting a question, groups solidified how they were going to operationalize the variables of interest (Step 3, 5 min). As they thought about how to measure the variables, students thought about how they would track and analyze the data they intended to collect. During this and subsequent steps I was available for guidance, but encouraged students to work with each other.

Students then devised their plan for gathering their information (Step 4, 5 min). They pilot tested or tried out their methods on other groups and made adjustments as time allowed.

In the fifth step (20 min), students gathered the information using the methods they had decided upon in the third and fourth steps. Some groups were able to collect their data from people in class and the surrounding area[‡]. Other groups needed to go to specific locations on campus.

Two members of the group were to serve as the information gatherers, and the third was to "observe the observers." Although everyone was to conscientiously record their observations, the observer of the observers acted as the recorder of the process and documented issues or problems that arose. He or she was also assigned to critique the information gatherers and note any concerns that emerged. I specified the time that students were to return to the classroom.

After data collection, students brought their data to the computer laboratory for analysis (Step 6, 10 min). Most students used the SPSS program available on the computers in

[‡] I consulted my university's Internal Review Board before conducting my research exercise. The IRB determined that further IRB approval was not necessary because the data were for in-class use only. If there are IRB concerns at other universities, students in fields that work with human subjects can collect their data by surveying or observing classmates.

our laboratory. For classrooms without student computers, one or two laptops with access to statistical software or a computer spreadsheet program could be provided. Alternatively, the teacher could limit the studies to designs where complex statistical analysis is not necessary.

In Step 7 (10 min), students interpreted their results, answering their questions. They were encouraged to present a table or graph if they thought that it would help the reader understand their findings.

Students then incorporated their results into a short research report (Step 8, 10 min). Each report included the question the students chose and why, their clearly stated hypothesis, how they gathered and tracked their information, how they analyzed their data, the results, and their conclusion (i.e., the answer to their question or hypothesis). Of key importance was the final paragraph in which students described the issues that arose during their study: What were the problems that that they encountered and their solutions? What did the "observer of the observers" notice? How might they do things differently if they were to repeat the study?

After students submitted their reports, the class reconvened to talk about their research (Step 9, 20 min). This shared reflection turned out to be a very important part of the process, as students talked about their problems and solutions and learned how their classmates overcame theirs. My role was to lead the discussion, making connections between groups' experiences, reminding them of definitions, and suggesting alternative solutions.

Results

One week later, students (N = 15) completed a short questionnaire. Students responded to the 9 items on Likert scales, typically ranging from 1 (*not at all*) to 7 (*very*). Means and standard deviations for all survey questions appear in Table 2.

A dependent samples t test comparing their self-reported understanding before the exercise to their understanding after the exercise was highly significant, $t(14) = -5.292$, $p < .001$, $M_{\text{Before}} = 4.53$ ($SD_{\text{Before}} = 1.19$), $M_{\text{After}} = 5.87$ ($SD_{\text{After}} = .74$). Students found the exercise to be both interesting and useful. Furthermore, students recommended that the exercise be used in this course in the future and in courses at other universities.

Students' comments support the impact and value of the exercise. "I found the project to be challenging and also fun and interesting." "Broke down the steps/processes well." "Exposed me to the research process, very hands on and applicable knowledge." "Did a great job applying all the concepts we learned last quarter." "I feel like I have started a good background in research."

Table 2. The Means and Standard Deviations of Participants' Responses to Survey Questions

Survey Questions	*M*	*D*
How interesting did you find the exercise?	5.93	1.10
How useful was the exercise in helping you understand the research process?	5.47	0.92
How would you rate your understanding of the research process before the exercise?	4.53	1.19
How would you rate your understanding of the research process after the exercise?	5.87	0.74
How helpful was it to have class help you evaluate your potential questions?	5.73	1.28
How useful was it to have the "observer of the observer?"	4.93	1.59
How useful was the practice of operationalizing the variables?	6.00	0.76
Would you recommend that this exercise be included in this course in the future?	6.40	1.06
Would you recommend this exercise to professors at other universities?	6.27	1.10

Note. Students responded on 7-point Likert scales from 1 (*not at all*) to 7 (*very*). Students' understanding of the research process after the exercise significantly differed from their understanding before the exercise, $p < .001$.

Discussion

Taken together, the results suggest that the students found the exercise to be valuable, for themselves and potentially for other students and professors. Not all students cared for the "observer of the observers" (see Table 2). It is one thing to provide feedback along with others in class and another to be the one criticizing one's group members. In future iterations of the exercise, the observers recorded everything they saw, but did not record their evaluations of their observations. In discussion, reporting what they saw revealed the problems, while taking away the sting of criticism.

The class that participated in this initial exercise was small and the class period was long (2 h). I have since successfully replicated the exercise with larger classes and with shorter class periods. With larger classes, four or five students can be placed in small groups, or several groups can be randomly selected to present their potential research questions or final results to the class.

With shorter classes, I placed limits on the steps or omitted steps altogether. For example, I limited students to producing and sharing one research question, limited research questions to those that can be answered in the classroom by surveying or observing classmates, or limited the time allotted for the steps. In other short classes, students orally presented their results, bypassing the creation of written reports. For classes short on time, statistical knowledge, or computer access, students can provide only descriptive results such as frequencies or averages from their studies. I have found that having a somewhat limited amount of time is actually beneficial in that it induces students to work quickly and efficiently.

In longer classes, more time can be allotted to the steps and professional reporting standards (e.g., American Psychological Association style) can be expected in the report. The exercise can also be stretched across two class periods, with question development through data collection on one day (steps 1 through 5), and data analysis, interpretation and presentation on the next (steps 6 through 9).

Although the class that gave feedback on this exercise already had a large knowledge base (over a quarter of statistics), I have used this exercise on the very first day of class of a two-quarter statistics and research methods sequence and a colleague used it successfully at the beginning of a statistics course (L.S. Wagner, personal communication, November 7, 2006). Students (alone or in pairs) follow the steps, skipping steps 2 (initial class feedback) and 6 (SPSS). They gather data from their classmates and in the end report what they have found. Students get an overview of the research process, make mistakes that they are unlikely to make again, and begin to feel like the researchers they can be.

The exercise is not meant to be students' only experience with the research process. Ideally, students would experience the research process often, and occasionally on a larger scale, where they investigate questions in the extant literature, derive appropriate methodology for their hypotheses, seek Internal Review Board approval, select appropriate samples, and so on until completing professionally formatted manuscripts. Although some undergraduate programs provide research experiences for all of their students, many do not. In addition, the majority of undergraduate programs do not have integrated research methods and statistics courses (Messer, Griggs, & Jackson, 1999). For those programs that do not offer full research experiences and integrated methods and statistics courses, an exercise like the one I offer allows students to experience the whole research process. Professors are encouraged to adapt the exercise to their class topic, size, and time, and to repeat the exercise as their schedule allows. As students' understanding becomes more sophisticated across the quarter, so do their questions and statistical and methodological approaches.

Although this exercise was designed and tested in psychology statistics and research methods courses, the outline of the process is applicable to statistics and methods courses in any subject area. Indeed, questions need not be domain-specific for the process to be meaningful. In analogous areas (i.e., the social sciences), students working in groups can create testable questions, or the seeds of questions that the class can help them develop, from the content learned in introductory courses. In the "hard" sciences (e.g., physics), teachers may want to provide an array of basic equipment around which questions should be devised. In any discipline, a teacher may want to circumscribe the questions or the data sets that students can use. Providing a list of possible topics to pursue or data sets around which to develop questions affords some limits while allowing students choice.

However other teachers choose to modify the exercise, I encourage them to maintain the suggested beginning and end – allowing students to choose their questions and having students share what they learn. I believe that encouraging students to pursue their own ideas leads to greater investment in the exercise. In my statistics and methods courses I use a variety of class experiments and activities that, while successful, never engender the excitement that this approach to the research process does. I believe that the other key piece to the success of this exercise is discussing what is learned, both from the studies conducted and from the exercise. The process of sharing provides a chance for students to realize what they have learned and to learn from the mistakes and successes of others.

Incorporating exercises that actively engage students in the entire research process combats students' compartmentalized conceptions of research and shows them the big picture. In addition such exercises afford opportunities for students to experience and solve the problems that researchers encounter, and in the end, to discover that they all can be successful researchers.

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