Building a Better Lecture Through Group-Based Discussion and PBL

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Workshop Handouts

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Sample Prep Guide with PBL and Key

Prep Guide Chapter 10

Please complete this prep guide and bring to class when it is due. The total point value for each prep guide is 5 points. The point value for each question is given in parentheses following the question. These prep guide questions cover book content as well as information intended to prompt you to extend your thinking about the book’s content.

NOTE—It is very important to your understanding of the material in this chapter that you answer EACH of these questions with as much detail and explanation as possible.

1. What does the term “repeated measures” mean? In addition to writing out the answer in words, provide an example using research notation for a two-group repeated measures design. (.5 pt)

Repeated measurements refers to multiple measures of one DV. That is, the experimenter measures that DV more than one time. An example of research notation might be something like this:

\[ O_1O_2O_3O_4 \]

2. Define and provide an example of the three kinds of correlated assignments. (.5 pt)

Matched pairs: Research participants who are equated on a key variable prior to the start of a study (e.g., each participant in the experimental group is paired with a participant in the control group on body weight at the outset of a study on exercise and mood)

Repeated measures: Measuring the same participants’ behavior more than once—as in pretest-posttest design—participants are perfectly correlated.

Natural pairs: Use of participants who share either a biological or social connection (e.g., twins, family members, married)

3. Explain the difference between between-groups variability and variability within groups (also called error variability). (.5 pt)

Between groups variability is variability introduced by the IV and ONLY the IV.
Within-groups variability is variability caused by sources other than the IV, such as individual differences, measurement errors, confounding variables (extraneous).

The design goal is always to max out \( V_B \) and minimize \( V_W \).

4. Explain why \( df \) is calculated differently for an independent two-group design than for a correlated or matched two-group design. (.5 pt)

Matched \( t \)-test \( df = N-1 \) where \( N = \) number of pairs of participants
Independent \( t \)-test \( df = N-2 \), where \( N = \) total number of participants in the study

The df is calculated differently because we have to treat pairs as a single unit, thereby reducing the total number of “participants” or unit in a study. Thus we have fewer “participants” or units of analysis in a correlated/matched design than we do in an independent design, everything else being equal.
5. Explain the statistical advantage of using a correlated group design over using an independent group design. (.5 pt)

Because each participant is serving as his or her own control in a correlated design, error variability should be reduced significantly. That is there will be essentially NO individual differences contributing to error variability or $V_w$.

6. When is it appropriate to use a correlated group design and when is it appropriate to use an independent group design? (.5 pt)

A correlated design should be used when you need additional control, have access to fewer rather than more participants, have participants who can participate in more than one session and are confident that IV will only have a small effect.

An independent design should be used when you have access to large numbers of participants, cannot easily match those participants on a key variable (or don’t need to), and are confident that your IV will have large effects.

Chapter 10 introduces us to two-group designs. Even though we’ve already talked a lot about these sorts of designs, there is a lot of new information in this chapter, and I think you will find it useful to helping you understand the logic behind two-group designs. We’ll begin learning about calculating the t-test with this chapter, so make sure you have your calculators with you every day in class.

The PBL below is worth 2 points.

Liam and Kdeye are working together to show that a new tutoring program in the psychology department improves student performance in the required undergraduate statistics course. Both Liam and Kdeye are anxious to see if the program is effective in helping students do better in the course because they actually designed the entire tutoring program. However, they both realize that, although they know and love statistics, they don’t know much about experimental design, so naturally, they come to you for advice. After listening to them describe what they wish to learn about the tutoring program, you counsel them on how to design their study using an independent samples design. Based on this information, please answer the following questions:

What is the hypothesis in this study?

Tutoring improves performance in the statistics course

Is the hypothesis directional or nondirectional? Directional

When they conduct the stats for this study will Liam and Kdeye use a one- or two-tailed test?

One-tailed test

What is the IV in this experiment? Tutoring

What is the DV in this experiment? Students’ grades in the statistics course

Identify the experimental group. Students who receive tutoring

Identify the control group. Students who do not receive tutoring

What is the operational definition of the IV?

Liam and Kdeye will operationally define tutoring as supplemental instruction given to students taking statistics involving review and practice of statistics for at least 1 hour outside of class time per week with a qualified tutor.
How the DV be measured?

Liam and Kdeye will record students’ final grades in the statistics course as their DV.

Using research notation, diagram the experiment you advise Liam and Kdeye to conduct.

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(Because students self-select for tutoring, random selection will not be used in this study)

Identify two potential confounding variables in this experiment

GPA and previous experience with math/statistics

For each of these confounding variables, explain how you will control for them.

GPA: Only students who have overall GPAs between 2.0 and 2.5 will be used in this study

Previous experience with math/statistics: Only students who have not taken a college math course or previous statistics class will participate in this study.

Identify whether any of the following threats to internal validity could possibly influence the outcome of this experiment and what advice you will give Liam and Kdeye for addressing these threats: history, diffusion, testing, and instrumentation.

History: History is not a real threat to this study because Liam and Kdeye’s design is not a repeated measures design—the DV is only being measured once.

Diffusion: Diffusion is a possible threat to internal validity because students in the study may talk among themselves about their grades, the tutoring experience, and make comparisons among themselves within groups and between groups.

Testing: Like history, testing is not a real threat to this study because the DV is only being measured one time

Instrumentation: Because all students will take the same tests and quizzes over the course of the semester, there is no threat to internal validity based on the tests/quizzes themselves. However, if these assessments involve essay questions or problems to be solved, then there is some threat to internal validity due to instrumentation because grading these assessments introduces the possibility of human error, including bias, fatigue, and boredom into the study.

After thinking about it some, you also wish to provide Liam and Kdeye with information on how to conduct an experiment testing their hypothesis using a correlated-groups design involving matched pairs. Accordingly, please respond to each of the following items:

In exactly what way will you match the pairs in this study?

GPA would be the most obvious choice for matching in this study.

Explain, in detail, why you selected this variable on which to match the pairs.

GPA is a variable that is determined by a combination of intelligence and students’ work ethic. It therefore represents a potent variable for predicting how well a student may due in any one course.

Using research notation, diagram this correlated group design.

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M O
After explaining to Liam and Kdeye how to carry out both an independent samples design and a within-subjects design, you discover, ironically, that neither Liam nor Kdeye are all that statistically talented. They apparently don’t understand why the *df* for these two designs are calculated differently. Please explain it to them:

**Degrees of freedom refers to the ability of any given number to assume a value within a distribution.** Restrictions are placed on degrees of freedom by statistical tests. In comparing the computation for degrees of freedom between an independent samples *t*-test and a correlated samples *t*-test, we find that these two similar yet different statistics place different restrictions on computation. In the independent samples *t*-test there are two groups or two distributions of data, whereas in the correlated samples *t*-test, the experimenter treats the collected data as one data set or distribution—hence, the difference in calculating degrees of freedom between the two types of *t*-tests.

After Liam and Kdeye successfully complete their research examining their hypothesis about tutoring and learning statistics, they send you an e-mail thanking you for your help and to let you know that they ran their study using both kinds of designs (in the fall, they used the independent-samples design whereas in the spring they used the within-subjects design). With great delight, they inform you that in both cases the outcome of their study was the same: they did indeed find that their tutoring program made a difference in students’ academic performance in the stat class. Based on their findings using both types of designs, what can Liam and Kdeye conclude about their generalizability of their results?

We can very likely conclude that the results or impact of this tutoring program will generalize to other students who seek tutoring for this particular statistics class at this particular college.
Sample Examination PBL

Psychology 2140 Research Methods       Name: _______________________________
PBL, Exam 3       Section: ____________

Below is one PBL question. It is worth 30 points. Please answer this question to the best of your ability. This portion of the examination is open book and open notes, but please do not borrow information from your classmates (in either spoken or written form). Please do not share your answers or any information about the questions below with classmates who are enrolled in the other section of the course (that would be diffusion of treatment of course!). When you are finished, please turn your exam in—after doing so, you are free to leave. Do Well!!!!

Jahvon and Sergei are two college students who work summers as head counselors for a youth development program for inner city children (ages 9-12) sponsored by the city government in their hometown. This program runs for 6 weeks and provides an opportunity for 600 children to learn about the benefits of physical exercise and nutrition. The goal of the program is to help local kids learn about the importance of exercise and good nutrition so that they can make informed decisions in the future about life-style issues related to leading healthy lives. The program is divided into morning and afternoon sessions with 30 children attending the morning session and the other 30 children attending the afternoon session. Each session lasts for 3 hours.

For this coming summer, the city has asked Jahvon and Sergei to implement a new curriculum for the program. The old program had children simply play sports games and provided healthy snacks between games—snacks such as oranges, apples, bananas, pure fruit juices and water, and so on. The new program will continue to have children play sports games and eat healthy snacks, but will also include two short “breaks” during each session that involve the counselors talking to the children about the benefits of exercise and healthy eating.

Because both Jahvon and Sergei have taken statistics and research methods courses in their college studies, they ask the program supervisor, Karina Escalante, if there is any evidence that this new twist to the program is more effective than the old program in helping children make good life-style decisions related to exercise and diet. Karina tells them no, none of which she is aware, but the mayor thinks it would be a good idea to have some actual “teaching” going on during the program so that students would have some underlying knowledge for why exercise and eating healthy make good sense.

Jahvon and Sergei then ask Karina if she thought the mayor would be willing to put his idea to the test—why not collect some data about the effectiveness of the program to see if it really works? Long story short, Karina takes the question to the mayor, and the mayor approves Jahvon and Sergei’s idea for conducting an experiment to test the two different programs.

Thus, Jahvon and Sergei decide to design the following two-group study. They will take the morning group of children and have them undergo the old program—all the physical activities and healthy snacks, but no “classroom-like activities” such as discussion of the benefits of exercises and what constitutes good nutrition. The afternoon class will experience the very same physical activities and eat the same type and amount of snacks as the morning group, but they will have two 15-minute “skull sessions” in which the counselors will give children oral, interactive presentations over how to exercise properly, how to eat healthy, and the benefits of doing both. These talks will be age appropriate in terms of content and language.

Because Jahvon and Sergei know the purpose of the study, they replace themselves with two other program counselors, Ursula and Lucia, both of whom have worked in the summer program for 2 years. Neither Ursula nor Lucia know that they are involved in part of a study. Jahvon and Sergei develop scripts for the skull session portion of the program and tell Ursula and Lucia to adhere as closely as possible to these written materials for the afternoon sessions during which the skull sessions will take place.

Although the mayor feels strongly that his new program will be superior to the old program in terms of producing children who are more knowledgeable about healthy life-style choices, Jahvon and Sergei are appropriately skeptical, and are adopting a “wait and see” attitude, reflecting their uncertainty about which program might be more successful in producing positive outcomes.
In addition to having two groups of participants, each of which receive a different version of the summer program, and having two uninformed counselors conducting the day-to-day elements of both program versions, Jahvon and Sergei decide on a few other important research design features. First, they decide to measure each child on (a) their knowledge of exercise and nutrition, (b) their level of physical activity (i.e., how much exercise they typical engaged in prior each day of the week prior the first day of the summer program) and (c) the kinds of foods they typically ate each day of the week prior to the first day of the summer program. They also will measure children on these same three variables 1 month following the last day of the summer program.

Second, Jahvon and Sergei decide to equate each child in the morning session with a corresponding child in the afternoon session with respect to the amount of exercise/sports equipment found in the home. Jahvon and Sergei reasoned that if children with more exercise/sports equipment in the home (e.g., baseball glove, basketball, footfall, bicycle, barbells) the more likely it would be for children to be physically active), so they want to make sure that both children in both groups are equated along this dimension. They also ask parents of all the 60 children to encourage their child to be physically active, eat well, and attend the summer program each day.

With this information in mind, please answer the following questions:

1. What is Jahvon and Sergei’s hypothesis? (1)
   a. Children in the morning session will outperform children in the afternoon session.
   b. Having children engage in exercise and eat healthy will increase their engagement in exercising and healthy eating following the 6-week program.
   c. Presenting children with information about exercise and healthy eating in addition to having them engage in exercise and eating healthy will increase their engagement in exercising and healthy eating following the 6-week program.
   d. Presenting children with information about exercise and healthy eating in addition to having them engage in exercise and eating healthy may or may not increase their engagement in exercising and healthy eating relative to merely engaging in exercise and eating healthy following the 6-week program.

2. Is this hypothesis directional or nondirectional? (.5)
   a. Directional
   b. Nondirectional

3. Will testing this hypothesis entail the use of a one- or two-tailed test? (.5)
   a. One-tailed
   b. Two-tailed

4. What is the IV in this experiment? (1)
   a. Having children engage in exercise and eating healthy
   b. Providing children with information regarding exercise and healthy eating in addition to having children actually engage in exercise and healthy eating for a 6-week summer program
   c. How often children engage in exercise and healthy eating following the 6-week summer program.

5. What is the DV in this experiment? (1)
   a. The children in the experimental group.
   b. Information about exercise and healthy eating.
   c. Their knowledge of exercise and nutrition and how often children engage in exercise and healthy eating following the 6-week program.

6. Identify the control group: (1)
a. The children who received information about exercise and healthy eating.
b. The children who received information about exercise and healthy eating in addition to actually engaging in exercise and healthy eating.
c. The children who only engaged in exercise and healthy eating during the experiment.

7. By having Ursula and Lucia, who did not know anything about the study, actually run the experiment, Jahvon and Sergei incorporated a ___________ control procedure into their experiment. (1)
   a. single blind
   b. double blind
   c. duck blind

8. What is the operational definition of Jahvon and Sergei’s IV? (1)

9. What is the operational definition of Jahvon and Sergei’s DV? (1)

10. Using research notation, diagram Jahvon and Sergei’s experiment. (1)

11. Identify one potential confounding variable in Jahvon and Sergei’s experiment (1)

12. For this confounding variable, explain how you would control it. (1)

13. Explain why Jahvon and Sergei chose not to use randomization as a control technique in their study. (1)

14. Given the nature of Jahvon and Sergei’s experiment, ___________ is a highly likely and genuine threat to the internal validity of their study. (1)
   a. statistical regression
   b. mortality
   c. history

15. Is there a possibility that diffusion could be a problem in Jahvon and Sergei’s experiment? (2)
   a. Yes
   b. No

If your answer is yes, explain how diffusion could be a problem.

16. What kind of t-test would Jahvon and Sergei use to determine if their findings are statistically significant? (2)
   a. Independent samples t-test
   b. Matched samples t-test

17. How many degrees of freedom will be present in the statistical analysis of Jahvon and Sergei’s experiment? (2)
   a. 60
   b. 58
   c. 29
   d. 28

18. Given Jahvon and Sergei’s hypothesis, the degrees of freedom present in this study, and assuming that they set alpha at .01, what is the value of critical t that they must obtain to conclude that their findings are statistically significant? (2)
   a. 2.390
   b. 2.462
   c. 2.660
   d. 2.756
19. Suppose that Jahvon and Sergei calculate their \( t \)-test and obtain a \( t \) of 2.58. Should Jahvon and Sergei conclude that their finding is statistically significant? (2)

a. Yes
b. No

20. Let’s forget about Jahvon and Sergei’s study for purposes of this question. Suppose you conduct an independent samples \( t \)-test and obtain a value of \( t \) of 3.67. You now wish to conduct the *Cohen’s d* test for effect size. Assuming that your study has 64 participants in total (32 in each group), what is your effect size? Please show your work. What can you conclude about the effect size? (3)

21. Okay. Back to Jahvon and Sergei’s study. In looking at a small sample of their data they collected at their 1-month post-experiment check, they notice that the two groups of children appear to show different amounts of within-group variability with respect to their scores on their knowledge test of exercise and nutrition. They decide to conduct a quick standard deviation calculation on this small sample. Here are the data from their small sample (the data below are based on the number of correct items for each child on the 10-item quiz regarding their knowledge of exercise and nutrition; data from only five children appear below). (4)

<table>
<thead>
<tr>
<th>Summer Program with Skull Session</th>
<th>Summer Program without Skull Sessions</th>
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</thead>
<tbody>
<tr>
<td>7</td>
<td>3</td>
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<td>9</td>
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Double check Jahvon and Sergei’s thinking by calculating standard deviations for both of these data sets. Show all your work. Were Jahvon and Sergei correct about the two groups showing sizeable difference in within-group variability? Use next page if needed for your calculation.

**BONUS QUESTION (2):**

Please explain (a) why the degrees of freedom for a correlated samples \( t \)-test is less than that for an independent samples \( t \)-test and (b) why this difference really doesn’t work as a disadvantage (statistically speaking) for the correlated \( t \)-test. ANSWER MUST BE IN YOUR OWN WORDS!
**Practice PBL/Case Study to Solve**

**INSTRUCTIONS:** Below is a description of a faculty member who wishes to become a better teacher. Given his situation, he comes to you for advice. Your task is to work with your partners to offer him suggestions for improving his teaching skills and to monitor his progress. That is, develop a specific plan for (a) enhancing his teaching skills and (b) monitoring his progress in achieving his teaching goals.

Chris is a fairly new faculty member at LSU—he is just beginning his third year at the university. He is a solid young researcher/writer/artist and is a good colleague in the department. He is well liked and respected by his faculty peers. However, he realizes after 2 years at LSU, he is not as well-rounded as he would like to be and that his teaching could be improved. He is not a bad teacher, but neither is he a particularly good one—and that is his goal to be a good teacher.

His student teaching evaluations indicate that he is a bit boring and uninteresting—students don't feel particularly engaged in his courses. They indicate that he is primarily a lecturer who relies exclusively on PPT for delivering his lectures. That is, his classes consist of no activities other than lectures. He gives two tests—a midterm and a final—during the semester. They are primarily MCQ and fill-in-the-blank. Many of his students indicate that his tests are hard and that his exams include material not covered well in class or in the book. He assigns homework and collects it, but never returns it. He arrives to class either just before it is time to start or slightly late. As soon as he finishes his lectures, he leaves class and heads straight for his laboratory/studio. He is pretty faithful about keeping his office hours and responds in a timely way to e-mail from his students. He is respectful of his students during class, although he can occasionally be rude to some students. On his course evaluations, his students often remark that they would like to go deeper into the material and be challenged more. They would also like Chris to bring more applications of his course content to class so that they can learn more about how the topics he teaches might generalize to everyday life.

In developing your plan to help Chris become a better teacher, keep in mind the following questions:

1. How will you confirm that his student evaluations are accurate and that Chris is providing you an accurate description of his teaching strengths and limitations?

2. Given what he has told you, how will you prioritize your suggestions for helping him improve as a teacher? What do you consider to be the most important things that Chris should do in order to improve his teaching? What ideas do you have for Chris for becoming a better teacher—that is, what is your detailed plan of advice for him?

3. How will you help Chris determine if the advice you gave him and which he implemented, is actually working?
PBL Worksheet

PBL 1: Situational Problem

Topic addressed by the scenario: ______________________________________________________

Skills and Knowledge Students Need to Solve this Problem: ________________________________

Situation: _________________________________________________________________________

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Solution to Problem (Rubric):  

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PBL Worksheet

PBL 2: Case Study Problem

Topic addressed by the scenario: ____________________________________________________

Skills and Knowledge Students Need to Solve this Problem: ____________________________

Situation: ________________________________________________________________________

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Bibliography for Workshop and Related Resources


National Center for Case Study Teaching: http://sciencecases.lib.buffalo.edu/cs/