

## **Chapter 14: Research Analysis and Critique**

### **Sample Research Critique #1**

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#### **The Assignment:**

The purpose of this optional assignment is to help you synthesize course concepts and apply them to research in your particular field of interest (that is, your specific program, be it Rehabilitation Counseling, Gifted and Talented, Secondary Ed, Special Ed, Adult Ed, Early Childhood, Rehabilitation of the Blind, Instructional Resources, Elementary Ed, or some other program). (If you are without a program, simply focus on any field or topic that would benefit you.) I'm certain you are in a position now to connect what you've learned in this course to published research in your area of interest. This can be accomplished by answering some questions and then writing a short review or critique of published research.

#### Research Selection

Your task is to locate a published research report that we haven't worked with in this course. You can locate it anywhere, on the Web or in the printed journals in a library. It must be empirical, that is, contain data used to answer a research question or test a

research hypothesis. The inclusion of data and its analysis (quantitative or qualitative) is a requirement, so that excludes mere reviews of research or opinions from consideration.

Don't worry about working with an article that won't count. If it includes data, it'll count.

I hope that you find a data-based research report that might help you in your other classes. Many of you know the leading journals in your field better than I do. The "best" journals are probably print-only (at least for now), so you may want to make that trek to the library. But again, you don't have to—any research report in a journal off the Web is fine. (Recall from a previous assignment that there are good sites which direct you to full-text online research reports available on the Web.)

This assignment involves careful reading of Chapter 14.

### Research Analysis

1. State the complete reference for the research (including the author, title, journal, pages, and URL, if applicable).
2. Write a paragraph describing the researchers' constructs (if any), their operational definitions, their different types of variables (as relevant, including independent, dependent, attribute, and key extraneous ones), and the research hypothesis (or research question).
3. Write a paragraph describing the type of research, the sample, and the instrumentation (measures).

4. Write a paragraph describing how the researchers addressed the issue of bias and control, the type of research design they used, and (very briefly) how they analyzed their data (the type of statistical tests, qualitative approaches, etc.).

5. Write a brief paragraph describing the researchers' results and conclusions.

### Research Critique

Now that you've fully dissected (analyzed) this research report and understand it well, you are in a good position to write a brief critique or critical review, focusing on its purpose, your overall reaction, salient methodological issues, noteworthy weaknesses and strengths, and an overall recommendation (like whether anyone should pay attention to it or whether it should have even been published). Think of this task in the same way you would a book review (except it's a research review): You tell the reader what the research is all about and then you make some judgments based on reasonable criteria. Book reviews help people decide whether they want to read the book. Similarly, research reviews help people decide whether they should attend to the research and possibly change their thinking or practice as a result. It seems like this critique or review could be done in about 3 to 5 pages.

Let me also add that reviews are not easy. You are not expected to spend 50 hours, but you know for sure how plodding it is to read research. And you know how slow technical writing is. This assignment will clearly take more than an hour, but not 30 hours, I'm sure, depending on how comfortable you are with all the terms and being able to "think

like a researcher.” Because you can choose a research report in your field of interest, it should be a bit easier to analyze and critique than the articles referenced in the text or, for sure, Russell and Haney. That’s because you’ll have greater familiarity with the jargon and related literature since you’ve been exposed to it in your program classes.

### **Sample Research Analysis & Critique #1 (used with permission):**

Research Analysis and Critique of Dona Bailey, a graduate student at the University of Arkansas at Little Rock

#### 1. Citation

Beccue, B., Vila, J., & Whitley, L. (2001). The effects of adding audio instructions to a multimedia computer based training environment. *Journal of Educational Multimedia and Hypermedia*, 10(1), 47-67.

This is available online at [www.aace.org/dl/files/JEMH/JEMH112177.pdf](http://www.aace.org/dl/files/JEMH/JEMH112177.pdf)

#### 2. Descriptions

##### Constructs

Constructs are factors that cannot be observed directly. To be useful in answering experimental research questions and testing hypotheses, constructs must be defined operationally, or measured and described as a quantifiable value.

In this study, the most important construct is learning. “How much” learning occurs as a result of the treatment is the foremost research question used in the study. The other two

constructs considered are the students' perceptions of the instructional material and the students' attitudes toward the lab session.

### Operational Definitions

Operational definitions are measurements used to define constructs. Constructs must be measured quantitatively in order to be useful in hypothesis testing.

In this study, the most important construct, learning, is defined as a measurement or test score indicating performance achievement in the treatment group and the control group. In this case, learning is measured by a student's test score. A student's test score is used to indicate the amount of material retained or the amount learned.

The other two constructs of interest in this study, student perceptions and attitudes, were operationally defined by collecting qualitative feedback from the treatment group about how students regarded the instructional material if it had audio added and the students' attitudes toward the lab session if audio was added. This qualitative feedback was collected in the form of comments from students in the treatment group. Collecting qualitative information resulted in an inability to statistically test this part of the information. This inability is discussed further in section 6 – Research Critique.

### Independent Variable

An independent variable is a factor that is applied in the treatment group and controlled for in the control group so its effect can be measured using the dependent variable. This

study's independent variable is the addition of audio instructions to an existing multimedia computer lab exercise. The treatment group received the addition of audio instructions, and the control group's lab exercise had no audio.

#### Dependent Variable

The dependent variable is the study variable that may be influenced or changed because of the independent variable. This study's dependent variable is the measure of students' performance achievement, or the test score students receive on the posttest. More specifically, the study's authors look at the amount of change in pretest and posttest scores.

#### Attribute Variables

Attribute variables are subject characteristics. The attribute variables considered in this study are gender and age. The study's authors are concerned if the addition of audio instructions significantly changes students' performance based on the demographics of gender and age.

#### Extraneous Variables

Extraneous variables are controlled influences. I do not recognize that there are any extraneous variables in this study.

#### Research Hypothesis

The researchers stated, “Based on the review of literature it was hypothesized that the additional audio component would be beneficial to the student’s lab learning experience” (p. 50). Because of the operational definition of the construct learning, this means that it was hypothesized that the addition of audio instructions would raise students’ test scores in the treatment group.

Here are the four null hypotheses that are detailed in the text of the study (pp. 61 and 62):

Ho 1. There is no significant difference in the performance of students who received audio instructions in addition to the lab manual instructions and students who did not.

Ho 2. There is no significant difference in the attitudes and perceptions of students who received audio instructions in addition to the lab manual instructions and students who did not.

Ho 3. There is no significant difference in the performance between males and females who received audio instructions in addition to the lab manual instructions and students who did not.

Ho 4. There is no significant difference in the performance among students of differing ages who received audio instructions in addition to the lab manual instructions.

Research Questions

The study's authors stated, "The major purpose of this study was to determine if the addition of an audio component had an effect on the learning and attitudes of the students" (p. 50).

The study's authors wrote, "The principal question investigated was: Does the addition of audio instructions increase the amount of material retained in a multimedia lab?" (p. 56).

The authors continued, "Does the addition of audio instructions change the students' perceptions of the lab material? Does the addition of audio instructions change the students' attitudes toward the lab material? Does the addition of audio instructions change the students' performance based on demographics?" (p. 56).

### 3. Research Description

#### Type of Research

This study is quantitative research, meaning it is based on, and analyzed using, numbers and measurements. The study is also practical research, in that it is a blend of theoretical and problem-based research. It has a theoretical component because it is ultimately aimed toward defining the best methods for creating multimedia CBT materials, and it also attempts to improve a course where students were not performing well (p. 49).

It seems to me that this study is teacher research (meaning it is an activity intended to improve teaching practice in the specific applied computer science course) hoping to be

traditional research that will improve methods and understanding of creating and developing multimedia CBT materials in higher education.

### Sample

The subjects for this study were 86 students enrolled in an applied computer science course at a midwestern university (the name was not specified, but the researchers teach at Illinois State University, in Normal, IL). The full population for the study was the entire enrollment in the applied computer science course. The course had five lecture sections consisting of approximately 40 students each. Each lecture section was divided into two labs, each of which met at different times during the week. Because of the way in which courses were already organized, the researchers used the intact groups (the lecture sections divided into two labs) and randomly assigned (the researchers label the procedure as “randomly dividing,” p. 56) the two lab sections within each lecture section to treatment or control groups. This procedure resulted in five control groups and five treatment groups of approximately 20 students each.

All students were required to participate in the lab for the course, but students were not required to participate in the study, and many students elected not to participate. All in all, this method of obtaining a sample is sometimes called a “convenience” sample instead of a random sample. This is discussed further in section 6 – Research Critique.

There are two pages of tables of group demographics presented in the study (pp. 57 and 58). The treatment group sample size was 37, and the control group sample size was 49.

Both groups were primarily male, but in the same proportion (the treatment group had 27 males to 10 females, and the control group had 37 males to 12 females).

### Instrumentation

Data for this study was collected only during week seven of an applied computer science course. In this study, three types of data were collected:

Test data in the form of students' scores on pretests and posttests. Pretests were given to all students in the lecture session of the class during week six, which was the week prior to treatment. Posttests were given in the lecture session during the week following the lab activity. This was the typical test schedule for the course. The authors did not include a description or analysis of the pretest or posttest reliability or validity.

Qualitative data were collected from subjects in the treatment group. This was presented via questions on computerized screens at the end of the lab session. These questions were concerning the students' perceptions and attitudes about the lab's audio component.

Another type of data was an electronic log file that tracked when a student played each audio clip and if the student repeated the clip. The authors thoroughly described the audio component intervention that was the study's independent variable. Audio instructions consisting of 60-second clips were presented to only students in the treatment group. The audio instructions matched the information presented in the lab manual except

that the wording was made “conversational” so it would sound natural when spoken. A professional radio performer was chosen to record the audio clips. Students were required to listen to all the audio clips and to listen in a specified order. After the clip had been played once, it could be played an unlimited number of additional times. This information was kept in a log file for each student.

#### 4. Research Design

##### Bias and Control

There seem to be a number of bias issues in this study. The largest and most critical bias is the problem of non-randomness. The process of selecting subjects for a sample is not random, as discussed under Sample in section 3 – Research Description. Also, the process of forming treatment and control groups is not random (as discussed under Sample in section 3 – Research Description).

In a section titled “Limitations of the Study,” the researchers acknowledge three problems (p. 61):

The design was unbalanced (the treatment group had 37 subjects, and the control group had 49) because intact groups were used from the course.

Using intact groups resulted in the authors’ inability to properly randomize the sample selection and group formation.

Students were able to interact during the week when the research was done, meaning students in the treatment and control groups may have discussed their participation in, perceptions of, and attitudes about the study between the pretest and the posttest.

I agree that these are bias problems in the study, and I believe there are others the researchers do not discuss. One bias that seems to further invalidate the sample selection is the large number of students who elected not to participate in the study. Of the potential 200 students who were eligible for inclusion in the study (five lecture sections of 40 students each), only 86 elected to participate. Who were the students who agreed to participate? What was their motivation? Who were the students who did not participate? Were they likely the best students? Maybe the worst students? Also, it's not clear when the students elected not to participate. Did they initially agree and then decline for some reason? There's no way to know the answer to any of these questions from the information reported in the study, but allowing opting out is a far from random method of selecting a sample.

The researchers report the treatment group subjects wore headphones during the study's lab session, but wrote nothing about wearing headphones being a biasing factor.

However, wearing headphones seems to me to be a problem in the study. In college, students may have concerns about how their hair looks and, depending on the style of the headphones, may not want to wear headphones. When the treatment group students put

on headphones in the lab, they were different from students in the control group and students who were not participating in the study, so the authors and any other study observers were not blind. Moreover, the subjects themselves could not forget for the amount of time of the intervention that they were subjects in a study. The treatment group subjects may have been experienced the Hawthorne effect, in which subjects behave differently because they know they are being studied. The Hawthorne effect is normally neutralized by including a control or placebo group. In this case, however, there was a control group, but no headphones were used by anyone else.

The last kind of bias that seems to be a problem is actually part of the way the researchers chose to try to bring control to the study. The researchers wrote that part of the demographic information collected about students was self-reported high school GPA and percentile ranking at time of high school graduation (p. 56). (I also noticed when this information is presented in tabular format on p. 58, it is not labeled as self-reported. This seems to me to be an error in the way in which the report is written.) The researchers wrote that this self-reported high school information was used as a “covariant measure” in the statistical analysis to remove biases due to the nonrandom selection of the lab groups. Self-reported information is a very poor basis to use for trying to remedy and control subject selection.

This list of biases poses numerous threats to internal validity in this study.

Research Design

This study is definitely an experimental design because it is based on an intervention. However, instead of using a truly experimental method, meaning properly applying an independent variable with proper random assignment to groups, this study uses a quasi-experimental method where there is a manipulated intervention but no true random assignment. The design loses a great deal of power because of its nonrandom sample. This problem alone means the study has little external validity, or applicability to a larger population.

#### Data Analysis

The research design used an ANCOVA (Analysis of Covariance) test to compare the pretest scores with posttest scores for the treatment and control groups. The text of the study indicates that “dependent measures” included pretest and posttest scores, while the “covariant measure” was “student reported high school grade point average (GPA)” (p. 61). Tabular data shows the means and standard deviations for each group for pretest and posttest scores, along with the amount and percentage change between the two (p. 63).

#### 5. Results and Conclusions

The results of the ANCOVA test revealed no significant difference in posttest scores for treatment group students, so the first null hypothesis, no performance differences for students in each group, was not rejected. Both groups increased their scores from pretest to posttest, and the treatment group students had a greater increase in scores than the control group, but the increase was not significantly different.

The second null hypothesis, no difference in the attitudes and perceptions of students in each group, could not be quantitatively analyzed because only qualitative data was collected from students in the treatment group.

Results showed no significant difference in performance for males and females, so null hypothesis three was not rejected. Null hypothesis four was not rejected since results showed no significant difference based on age categories.

The researchers concluded that adding an audio multimedia component results in no significant difference in learning. The researchers also used qualitative data about perceptions and attitudes along with observations made at the time of data collection to draw additional conclusions and make recommendations. The researchers concluded (p. 64), “Based on observation of the subjects, the researchers theorized that the pace set by audio might be helpful for slower learners and detrimental to fast learners who want control of their learning environment.”

The researchers also made recommendations for future research (p. 64). Some of their recommendations are to collect data from a larger, more randomly selected population in differing subject areas, using varying subjects of differing technical levels.

## 6. Research Critique

I spent a long time looking for a study with hypotheses concerning multimedia components of instructional materials. When I found this study and when I initially considered it, I thought it looked impressive and valid. When I had thoroughly digested its sections, however, I think overall the study is a bit of a mess.

The abstract is written in a way that seems much cleaner than the full study. The literature review is very interesting to me and seems very professional. However, there is a section at the beginning of the study that, after I had completed reading the study and understood it all, I think is where things began to go wrong. The authors wrote that a course that had previously been a lecture course had been revamped into a lecture plus lab course. After two semesters of the new course structure, students were not performing as well as expected (p. 49). The authors wrote in this section that the major purpose of the study was to determine if adding an audio component would improve student performance in this particular course situation (p. 50). In another section, the study's purpose is stated to be an investigation of whether the addition of an audio component in multimedia CBT results in students achieving higher test scores (p. 55). This seems to be a question about a generalized situation. These two scenarios are very different. Trying to improve a specific class situation where there are already specific students having difficulties is very different from a "clean," generalized situation with new material and fresh students. True experimental research must be conducted in a fresh, unbiased situation, not brought in as a remedy for a situation that has already gone wrong.

Overall, I think this is a study that wants to be theoretical research, but needs to be goal oriented in order to try to improve the specific course situation. Because of these restrictions, the specific student population was already in place before the study was created. No wonder the researchers used “intact groups” from the specific class.

It’s unfortunate that there are so many problems with this study. The basic research questions are very good, and not enough research has been done studying the effects of multimedia instructional materials in higher education.

To the researchers’ credit, the treatment seems well designed, and since I know that creating multimedia instructional materials is very time consuming, I feel certain the researchers spent a lot of time and deliberation on the audio component used for treatment.

This study should be reworked, improved, and conducted again. The aspects that should be improved are:

Obviously a truly random sample needs to be used.

The biases discussed in previous sections need to be controlled. Using a random sample would improve many of these issues.

A quantitative survey instrument should be developed and used to collect attitudinal and perceptual data instead of collecting qualitative information.

The survey should be used to collect data from both groups of students, instead of only the treatment group, so that attitudes and perceptions about the instructional materials and methods can be compared for the two groups.

A longer amount of time and exposure to the treatment needs to be used. Data for a complex research question cannot be gathered in one week's meeting of a college class. Exposure to a complex treatment cannot be completed in one lab session. Using at least one semester of data seems more appropriate.

The rules for playing the audio clips should be redesigned. Why are students forced to play all the clips and to play them in a certain order? Allowing students to set their own rules about utilizing the audio component and then analyzing the data recorded in the log file seems like a much richer source of information.

Finally, this area of research is uniquely tied with what is known about learning styles. I expect that there is not one answer to the question of whether the addition of an audio component in multimedia CBT results in students achieving higher test scores. Based on the amount of information understood about the variety of learning styles, I don't think that is a surprising or extraordinary prediction. For this study to be done in the very best way so that findings and conclusions could be truly useful, it should include studying the

ways in which individual learners utilize audio instruction components. To carefully include that aspect would necessitate another careful reworking of the research design, but it seems that would be possible using care and deliberation.