The Effect of Treatment Diffusion on Educational Experimental Designs

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ABSTRACT

The purpose of this study was to determine how powerful the treatment diffusion effect is on experimental designs in education within the Nigerian context. The participants were 108 secondary school students. The treatment group watched a documentary about the role of women in bringing peace during the Liberian civil war while the control group was engaged in reading unrelated short stories. At the end of the treatment, both groups completed the questionnaire about the treatment video. Results found a significant difference between students in treatment and control groups in their knowledge of the treatment topic but no significant difference was found in their interest in the treatment topic. Therefore, it was concluded that treatment diffusion is not a threat to the internal validity of experimental designs in Nigeria.

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INTRODUCTION

Educational research has a powerful role to play in educational development in Nigeria. The purpose of educational research is to develop new knowledge about the teaching-learning situation to improve educational practice (Gall, Gall, & Borg, 2003). By collecting data through the scientific method about important topics in education, educational research can establish the best practices that teachers, counselors, administrators, and students should use to improve learning outcomes.

Experimental designs are the most powerful research designs for identifying best practices in education because they compare new educational practices with existing practices. In experimental designs, a treatment group that receives the new educational practice is compared to a control group that receives the typical educational practice. After students receive their specified educational intervention, both groups are assessed on important learning outcomes such as their performance, effort, and motivation. The comparison between the treatment group and the control group on these dependent variables provides evidence about which educational practice is more effective.

However, the quality of an experimental study depends entirely on the how well the researcher plans the experiment. The researcher must thoroughly control the research study to ensure that the treatment and control groups are identical in every manner except for the fact that the treatment group receives the new educational practice.. Experimental studies are considered internally valid if they are designed in such a way that they control for extraneous variables, which are any variables that affect the study's outcome and provide an alternate explanation for the study's results (Gall et al., 2003). In order to confidently conclude that the treatment is effective, there must be no alternate explanations for the difference between the treatment and the control group on the dependent variable at the end of the study.

For example, consider a research design where the treatment group has one teacher and the control group has a different teacher. In this study, the teacher for the treatment group was a very good teacher, whereas the teacher for the control group was poor. If the treatment group has higher academic performance at the end of the study, then it is most likely that the treatment group performed better than the control group not because of the treatment, but because the treatment group had a better teacher. Having different teachers is thus an extraneous variable, and the study is considered not valid because the researcher did not

properly control for the quality of the instructor. Instead, the researcher must control the study by using the same teacher for the treatment and control groups. Then, at the end of the study, it would be clear that the treatment group performed better because of the treatment, not because of the teacher.

There are many factors that can threaten the internal validity of a research study, one of which is called treatment diffusion. This occurs when the control group is affected by the treatment because the individuals in the control group are taught by the participants in the treatment group (Trochim, 2006). For example, if both the treatment and the control groups are comprised of students within the same school, then during the time that they are not in class, the children in the treatment group may teach what they have learned in the treatment to the children in the control group. As such, the treatment will have an unnecessary effect on the children in the control group. This would mean that the treatment would improve the posttest academic performance of the control group. Therefore, treatment diffusion would make it difficult for a researcher to determine whether the treatment program was effective because both the treatment and the control groups are benefiting from the treatment. This decreases the chances of determining whether the treatment is, in fact, effective.

Because of the threat of treatment diffusion, many researchers in Nigeria suggest that the treatment and control groups should be located in different schools. They argue that if the treatment and control groups are in the same school, then the students in the treatment group will teach the students in the control group what they have learnt, which would negate the effectiveness of the treatment. As a result, the researcher would not find the treatment effective at the end of the study. To avoid this, these researchers advise that the treatment group be assigned to School A while the control group be assigned to School B.

However, a contrasting concern in experimental designs is to ensure that the treatment and the control groups are identical in every fashion except that the treatment group receives the treatment. This is the threat of differential selection (Gall et al., 2003). Differential selection means that the individuals were selected differently for the experimental and control groups, in this case, they were differentially selected based on their school. If the treatment and the control groups differ at the beginning of the study, such as by attending different schools, then any differences between the two groups on students' performance at the end of the study cannot be attributed to the treatment because the two groups were different even before the treatment occurred.

Thus, if the advice of the previously mentioned researchers are followed and the treatment is assigned to School A while the control is assigned to School B, then there are

likely differences between the treatment and the control group at the start of the study. Perhaps School A is better managed than School B. Perhaps the students at School A are more committed to their work. Or perhaps the length of the school day in School B is longer, so students get more time to study. Any of these extraneous variables, and hundreds of others, may impact students' academic performance in addition to the treatment. Because of these potential extraneous variables between different schools, other researchers advise that the treatment and control groups be located within the same school.

Thus, one group of researchers advises that the treatment and control groups be located in different schools to avoid the treatment diffusion effect. Another group of researchers advises that the treatment and control groups be located in the same school to avoid the impact of extraneous variables through differential selection. The purpose of this study is therefore to determine which group of researchers provides the soundest advice to educational researchers.

To do this, the study will determine how powerful the treatment diffusion effect is in the Nigerian context. We designed the study in such a way that we were most likely to find the treatment diffusion effect. Thus, if treatment diffusion does not occur in this study, it likely will not occur in any educational study in the Nigerian context. First, we conducted the study in a boarding school so that students spend a maximum amount of time together, increasing the chances of the treatment group teaching what they learnt to the control group. Second, we used a boarding school with a high academic reputation. The students who attend this school are very committed to their studies, so if any students would teach each other, it would be these students. Third, we conducted the study while students were waiting for the results of their exams. Since no classes were in session, the students had no other pressing courses to study for and therefore would be most likely to share what they learnt in the treatment. Because of these three factors, if any students would teach the treatment to the students in the control group, then it would occur in this study. Four variables were identified as dependent variables to determine the effect of treatment diffusion on educational experimental designs. The first variable was knowledge of the treatment topic, which is the same as academic performance. Since a key purpose of education is to improve students' knowledge, this was the most important dependent variable. However, as motivation plays a key role in educational attainment (Eggen & Kauchak, 2004), a motivational variable was also identified: interest in the treatment topic.

Two additional variables were also selected. Some researchers argue that having the treatment and control groups in the same school may make students in the control group have

a bad attitude toward the study, and therefore not put forth effort during the study. Furthermore, they argue that students in the control group may be jealous of the treatment group. As such, two additional dependent variables were attitude toward the experiment and jealousy.

RESEARCH HYPOTHESES

1. There is no significant difference between students in treatment and control groups in their knowledge of the treatment topic.
2. There is no significant difference between students in treatment and control groups in their interest in the treatment topic.
3. There is no significant difference between students in treatment and control groups in their attitude toward the experiment.
4. There is no significant difference between students in treatment and control groups in their degree of jealousy regarding the experiment.

METHODS

Research Design

The study made use of the experimental research design. This design helps in drawing causal inferences by attempting to establish if one variable caused another variable (Awotunde & Ugodulunwa, 2004). Specifically, the posttest only experimental design was adopted. The independent variable in this study was the treatment diffusion effect. In other words, one group received the treatment, which was watching the documentary *Pray the Devil Back to Hell.* The dependent variables were knowledge of the treatment topic, interest in the treatment topic, attitude toward the experiment, and jealousy regarding the experiment. If treatment diffusion was a factor in this study, then the treatment and control groups would have the same knowledge of the film. However, if the treatment diffusion was not a factor in the study, then the treatment group will have significantly higher knowledge of the film.

A pre-test was conducted to determine baseline knowledge of the topic. The results of the pre-test confirmed that students had no knowledge of the topic before the study.

Students were randomly assigned to groups to control for differential selection. To achieve random assignment, students were seated in an auditorium. The researcher went student by student to give them numbers, counting them off 1, 2, 1, 2. At the end, students who were assigned 1 were the treatment, whereas those assigned 2 were the control.

Participants

The initial participants for the study were a total of 108 senior secondary one and two students. Of these students who were assigned to the treatment and control groups, only 69

(comprising of 23 boys and 40 girls with three not indicating their gender) were able to fill and return their completed questionnaires.[1] Their age in years ranged from 13-17 with 14.7 years as average. Thirty-eight and 31 students were in the treatment and control groups respectively.

Instrument

The study made use of a questionnaire that measured the participants' knowledge of and interest in the treatment topic, as well as their attitude toward and jealousy regarding the experiment. The questionnaire had three parts. Part 1 contained personal information about the participants like sex and age. Part 2 had 10 open-ended knowledge items about the documentary to which the participants supplied answers. For example, one item was, "What is the name of the women's peace group described in the film?" Part 3 contained a total of 13 items on a six-point Likert scale of Strongly Disagree to Strongly Agree which measured participants' interest, attitude toward the experiment and jealousy toward the experiment. An example interest item was, "I am interested in learning more about the Liberian civil war." An example attitude toward the experiment was, "I enjoyed the after school program very much." An example jealousy toward the experiment item was, "I was jealous of the other group in the after school program."

Procedure

On the first day of study, the students were assembled in a hall and then randomly assigned to either the treatment or control group. The groups were taken to different classes, a safe distance from each other. The treatment group on the one hand watched a movie titled *Pray the Devil Back to Hell,* a documentary about the role of women in bringing peace during the Liberian civil war. The film lasted for about 70 minutes and features Leymah Gbowee, one of the most recent Nobel Peace Prize winners. On the other hand, the control group was engaged in reading short stories as well as playing a scrabble-word game while the documentary lasted. In the scrabble word game, students are given a large word, such as breathtaking, and asked to identify as many words out of the letters of the word as possible, such as breath.

Two days after treatment, a fairly considerable amount of time for students to discuss about the film, both treatment and control groups completed the questionnaire.

RESULTS

Hypothesis One

[1] During the time that the post-test questionnaires were being completed, some students were engaged in compound cleaning in anticipation of an important dignitary visiting the school the following day.

There is no significant difference between students in treatment and control groups in their knowledge of the treatment topic.

Table 1. Comparison of knowledge scores between treatment and control groups

	N	Mean	t	df	p	Decision
Treatment Group	38	6.76	16.12	67	<.0001	Sig.
Control Group	31	0.97				

Result of the t-test computed and shown in Table 1 provide a p<.001, which is less than 0.05. To this end, the null hypothesis is rejected. Therefore, there is a significant difference between students in treatment and control groups in their knowledge of the treatment topic. Students in the treatment group were able to correctly answer 6.76 out of the 10 open-ended items about the film, whereas students in the control group answered on average less than 1 item correctly. Therefore, treatment diffusion did not affect students' knowledge of the treatment topic.

Hypothesis Two

There is no significant difference between students in treatment and control groups in their interest in the treatment topic.

Table 2. Comparison of interest scores between treatment and control groups

	N	Mean	t	df	p	Decision
Treatment Group	38	4.86	1.72	67	0.090	Not Sig.
Control Group	31	4.45				

Table 2 shows that the calculated p value of 0.090 is greater than 0.05. The null hypothesis is hereby retained. Therefore, there is no significant difference between students in treatment and control groups in their interest in the treatment topic.

Hypothesis Three

There is no significant difference between students in treatment and control groups in their attitude toward the experiment.

Table 3. Comparison of attitude scores between treatment and control groups

	N	Mean	t	df	p	Decision
Treatment Group	38	4.74	3.04	67	0.003	Sig.
Control Group	31	4.09				

The table above shows that the calculated p value of 0.003 is less than 0.05. The data obtained has therefore provided adequate and sufficient evidence against the null hypothesis. The null hypothesis is hereby rejected. Therefore, there is significant difference between students in treatment and control groups in their attitude toward the experiment. Students in the treatment group had a more positive attitude toward the experiment than students in the control group. However, the students in the control group still had a positive attitude toward the study, as a mean score of 4.09 indicated that they "agreed somewhat" with the attitudinal items on the questionnaire.

Hypothesis Four

There is no significant difference between students in treatment and control groups in their degree of jealousy regarding the experiment.

Table 4. Comparison of jealousy scores between treatment and control groups

	N	Mean	t	df	p	Decision
Treatment Group	38	1.75	4.37	67	<.0001	Sig.
Control Group	31	3.02				

To test for hypothesis four, a t-test was computed. The computed p value was <.0001, so the null hypothesis is rejected. Therefore, there is significant difference between students in treatment and control groups in their degree of jealousy regarding the experiment Students in the control group had higher jealousy than those in the treatment group. However, since the scale ranged from 1 to 6, a score of 3.02 indicates that students in the control group "disagreed somewhat" with the items regarding jealously. Therefore, while the control group had significantly higher jealousy toward the experiment than the treatment group, they still had low jealously overall.

DISCUSSION

The purpose of this study was to examine the effects of treatment diffusion on experimental designs. First of all, the findings indicate a significant difference between students in treatment and control groups in their knowledge of the documentary. This means that treatment diffusion did not affect students in the control group. In other words, the knowledge of those in the treatment group was considerably higher than that of their counterparts in the control group.

Also, result shows no significant difference between students in treatment and control groups in their interest in the treatment topic. Both groups still had interest in the study. The fact that the treatment group had the privilege of receiving the treatment did not diminish the control group's interest level.

The outcome of the study also indicated a significant difference between students in treatment and control groups in their attitude toward the experiment. Students in the treatment group indicated a more positive attitude toward the study than those in the control group. However, students in the control group still had an overall positive attitude toward the study. This study was designed to maximize the difference between groups whereby the students in the treatment group were able to watch a film, whereas those in the control group read stories. Therefore, it is logical that the students in the treatment group would have a more positive attitude toward the study. However, the finding that students in the control group still had a positive attitude towards the study even though they did not get to watch a film shows that researchers should not be worried about differences in attitude toward the study between treatment and control groups.

Finally, a significant difference was found between students in treatment and control groups in their degree of jealousy regarding the experiment. The study elicited more jealousy among students in control group than their counterparts in the treatment. However, the finding that even those students in the control group still reported low jealously also demonstrates that researchers should not consider jealousy as a major factor in determining whether to use the same or different schools in an experimental research design.

To summarize, this study was designed in such a way that if treatment diffusion is a factor in experimental designs in Nigeria, then a treatment diffusion effect should have been found in this study. However, the results clearly demonstrated that treatment diffusion does not affect knowledge of a topic. Since knowledge is the primary variable in educational research studies, researchers should not consider treatment diffusion as a major threat to the internal validity of an experimental research design.

RECOMMENDATION

Because this study found that treatment diffusion does not affect knowledge of a topic, in experimental studies, both treatment and control groups should be from the same school. This will provide a much more valid outcome or conclusion in an experimental study. A study where the groups are drawn from different schools will, to a larger extent, invalidate the results because of disparity between schools.

CONCLUSION

In conclusion, treatment diffusion is not a threat to the internal validity of experimental designs. Its effects are minimal and not significant enough to warrant having the treatment group in one school and the control in another as is suggested by one school of thought.

REFERENCES

Awotunde, P.O., & Ugodulunwa, C.A. (2004). *Research methods in education.* Jos: Fab Anieh.

Eggen, P., & Kauchak, D. (2004). *Educational psychology: Windows on classrooms* (6th ed.). Upper Saddle River, NJ: Pearson.

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational Research: An Introduction* (7th ed.). Boston: Allyn and Bacon.

Trochim, W. M. (2006). *The Research Methods Knowledge Base* (2nd ed.). Retrieved online from http://www.socialresearchmethods.net/kb/

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