Do Order and Type of Instructional Materials Matter?

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ABSTRACT

This study was conducted to determine if the order of instructional material matters, and to compare the effectiveness of computer simulation software (SIDD) versus reading material. Participants included 11 College of Charleston upper-level psychology students. The participants were randomly assigned to one of the two conditions; reading material and SIDD versus SIDD and then reading material. Participants completed a pre-test, mid-test after exposure to one of the two learning materials (i.e., SIDD or reading material), and post-test following experience of both materials. Students' test scores improved once instruction was provided, no matter what type of instruction was provided (i.e., SIDD versus reading). Additionally, analysis of the test scores showed that there were no significant differences between order of presentation of instructional material. Most students reported that the SIDD program was most effective in helping them learn the material. Threats to internal validity include practice effects and/or history effects. Our study was also limited by a small sample size, which may have threatened the study's external validity. Future research needs to be conducted to address these issues.

The variety of instructional mediums used to deliver content material has burgeoned in recent years. Computers and web-delivery are bringing new methods to the menu of choices from which

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instructors can choose. An essential consideration in the selection of an instructional methodology is what will work best, in terms of student acquisition of the material, for the majority of students.

The research comparing the effectiveness of different mediums of instruction has revealed mixed results. In an experiment conducted by Marr, Plath, Wakeley, and Wilkins (1960), introductory psychology students were randomly assigned either to one of two reading conditions. In the first, instruction involved textbook reading material for the course and a once-a-week question-and-answer class; in the second, instruction consisted of a three-times-per-week lecture and textbook reading material. Students in the lecture condition performed significantly better on two of the three tests and the final exam compared to those in the textbook condition.

Williams and Zhed (1996) investigated the effectiveness of computer-based training versus the traditional lecture method. Fifty-four participants were randomly assigned to one of the two experimental groups: the computer-based instruction (CBI) or the traditional lecture group. Reactions of each group to their respective training program did not differ significantly. A highly positive response to the training process was found. CBI was at least as effective as the traditional lecture and discussion method for initial learning. However, CBI was more effective in terms of retention of acquired information one month following training.

With the advent of CBI, an important question is whether learning is enhanced from such exposure. Some research has found that the use of a computer program can significantly increase test scores as compared to traditional lecture instruction (Desrochers, House and Seth, 2001; Evans, Edmundson-Drane and Harris, 2000; Pelayo-Alvarez, Albert-Ros, Gil-Latorre and Gutierrez-Sigler, 2000; and Williams, Aubin, Harkin and Cottrell, 2001) while other researchers have found contradictory results. For instance, Labuda (1999) found no significant differences in test scores between participants using a text case study, a computer case study, and a regular lecture on the topic of educational psychology. Another study found that students in a traditional lecture condition performed significantly better than students in the computer-based condition when learning about radiographic exposure (Watkins, 1998). Kinzer, Sherwood, and

Loofbourrow (1989) compared reading to computer simulation conditions to teach fifth-grade students information about the food chain using a quasi-experimental research design. Teacher mediation and study sheets were used in both conditions. Participants in the reading condition performed better on the post-test than those in the computer simulated condition. In the computer simulation condition the whole class was exposed to the software rather than individually interacting with the material, which may have influenced the outcome.

These conflicting results indicate that more research is needed to determine which form of instruction best facilitates learning. This study compares students' test performance when instructed on the same topic via computer simulation versus reading material.

Another research question is whether the order of presentation of instructional materials matters. The research findings have been mixed on this issue.

Verdi, Johnson, Stock, Kulhavy and Whitman-Altern (1997) examined whether learners who viewed an organized spatial display before reading a text passage would recall more related text facts than the learners who read a text passage and then viewed a display. One group of introductory psychology participants viewed a map and then read a related text, while the second group read the text and then viewed the map. The group who were exposed to the map before the text recalled more facts, placed more correct labels on their reconstructions, and were more accurate in their placements than the text before map group. In a second study, 112 children from a large public middle school participated with the display-before-text group matching significantly more feature names with the correct facts than did the text-before-display group.

In contrast to Verdi et al.'s (1997) study, Noonen and Dwyer (1994) studied the effects of order of presentation of text and pictures in CBI and found that it had no affect on student achievement scores. Participants were 94 college students who were learning the physiology and functions of the human heart.

Given the research reviewed above, type of instructional method and order of presentation of multiple methods are topics the need further study. In the current study, participants were exposed to either a condition in which they read an article on the topic of functional

assessment and then used a computer simulation program that involved the same approach or a condition in which they used the computer program and then read the article. Participants' performance was measured before, after the first instructional session (i.e., reading or computer simulation) and following the second instructional session. Additionally, a questionnaire concerning preferences in instructional material was delivered.

Method

Participants

Participants were 11 upper-level psychology students, eight females and three males, ranging from 19-21 years of age, enrolled at the College of Charleston, a public liberal arts school in South Carolina. Students were approached through their Applied Behavior Analysis Psychology class. Compensation of six extra credit points for participation in the study was given.

Setting

Each instructional method was held in a separate computer classroom.

Apparatus & Materials

In this study, we used a computer based software program entitled *Simulations in Developmental Disabilities* (*SIDD*), and an article on functional assessment ("Functional Assessment: What It Is and How to Do It") by Desrochers, Coleman and Newell (2003).

Three versions of a Functional Assessment Knowledge (FAK) test and a demographic information form (with questions regarding age, GPA, year in college, major, computer experience, preferences for instructional method) were used in this study also.

SIDD software

This is an interactive program where the student is given information on a patient with a problem behavior, and must go through the task of assessing and treating that client. The student obtains information concerning the client through a screen presentation of a referral form, interviews, and graphed data. Video clips are available

with client information. The student must determine what is causing the client's problem behavior, and design a treatment program for their client. Feedback is given during the program in the form of textual statements, scores, and graphs showing the treatment effects (for more information on this program see Desrochers and Hile, 1993). The software was presented on Dell computers with Windows 98 operating system. Audio from the brief video clips was delivered on the computer's speakers.

The Functional Assessment Knowledge Test (FAK)

This test consisted of 24 questions, including multiple choice, short answer, and fill-in-the-blank questions. These covered both application and factual (definition) information. These tests were used to get a baseline of the student's knowledge of functional assessment, and how well they learned the information after each session. Each test contained questions covering the same concepts, however the question stem involved different client cases.

Functional Assessment Reading Packet

This article is a brief overview of functional assessment (Desrochers et al., 2003). Information is presented in an outline format and includes graphs and charts. At the end of this packet is a list of questions. These include short answer, definitions, and multiple choice. The answers to these questions were included so the student may check their answers to make sure that they fully understand the material.

Procedure

Once students decided to participate, a demographic information sheet along with an informed consent form were administered. The participants were randomly assigned to one of the two conditions according to presentation order, Reading-SIDD or SIDD-reading. All the participants began the study by taking a version of the FAK. This test takes about 45 minutes to complete. This pre-test was used to obtain a baseline of the participant's level of knowledge on functional assessment.

During the first class period, the students completed their

assigned lesson. Each of the two instructional methods took about one hour and 15 minutes. The two conditions were held in separate rooms. The SIDD condition began by the instructor demonstrating a sample client case for the first 10 minutes of their class time and gave all students a handout on the program. The students were then instructed to go through the program with another client case independently. In the reading condition, the students were given the reading packet and instructed to read it fully and to answer the questions at the end. Students in both conditions were allowed to take notes during their session.

The following day, all students returned to a separate room to complete another version of the FAK. During the next day, the students were exposed to the instructional method that they had not previously received. On the next day, a final version of the FAK and a questionnaire concerning student's opinions regarding the two instructional methods, including the degree that they enjoyed the programs and the degree of their effectiveness, were handed out and completed. Following completion of the questionnaire, a debriefing statement was handed out.

Results

In this study, we found a significant difference across the three knowledge tests but no significant difference between the two conditions comparing type and order of instructional materials. A repeated measures ANOVA found a significant difference for overall scores on the three tests ($F(2,8) = 4.31$, $p<.05$) and no significant difference between conditions ($F(1,8) = 1.595$, $p>.05$). A post hoc analysis revealed a significant difference between pretest and midtest. As seen in Figure 1 test scores were comparable for both instructional methods and overall scores increased from pre-test to mid-test.

As seen in Table 1, mean test scores were similar between Reading-SIDD and SIDD-Reading conditions across the three tests. Also an improvement from the pre-test to the mid-test occurred following instruction with SIDD or Reading methods. An independent sample t-test found no significant differences between SIDD vs. Reading conditions for overall knowledge mid-test scores ($t(9) =.49$, $p>.05$).

We further analyzed the type of question item contained in the knowledge test into four categories (i.e., definition, application, open-ended and multiple choice). A repeated measures ANOVA found a significant difference for definition items across the three tests ($F(2,8) = 7.73$, $p<.01$) with no significant difference between conditions examining the order of presentation of instructional materials ($F(1,8) = 0.06$, $p>.05$). A post hoc analysis revealed a significant difference between pre-test and mid-test and between pre-test and post-test. (As seen in Figure 2 scores for definition items increased from the pre-test to the mid-test and from the pre-test to the post-test). A repeated measures ANOVA revealed no significant difference across the three tests or between conditions for application type items (see Figure 3). A repeated measures ANOVA found a significant difference for open-ended items across the three tests ($F(2,8) = 12.18$, $p<.01$) and no significant difference between conditions ($F(1,8) = 0.45$, $p>.05$). A post hoc analysis revealed a significant difference between all three tests. As seen in Figure 4, midtest scores increased from pre-test scores and post-test scores increased from mid-test scores for both conditions. A repeated measures ANOVA found no significant difference for multiple choice items across the three tests or between conditions. See Figure 5 for individual detailed scores for multiple choice items across the three tests and both conditions.

As seen in Figure 6, SIDD was rated better overall at teaching functional assessment skills (M = 3.9) compared to reading on a scale from 1 (reading was most effective) to 5(SIDD was most effective). Table 2 provides mean scores for perceived effectiveness of SIDD and reading at teaching certain target objectives (i.e., formulation of behavioral definitions, conducting functional assessment). Table 3 displays mean scores for perceived usefulness of SIDD and reading for certain target objectives (i.e., teaches behavioral assessment skills, teaches behavioral treatment skills)

Discussion

Our results showed that overall test scores significantly increased from the prestest to the midtest, but that there was no significant difference in terms of type and of order of presentation of instructional material. Although both conditions improved from pretest

scores, there was no difference in test scores between SIDD and reading material for condition alone. Participants also rated SIDD as more effective than reading in teaching functional assessment skills.

Our results are similar to those found by Williams and Zhed (1996) in that they too did not find a difference in performance between their computer based training group and lecture method group. However our results do not match those found by Watkins (1998) in which students in a lecture group performed significantly better than those in a computer-based group.

Our results are also similar to those by Noonen and Dwyer (1994) in that they found no difference for order of presentation of text and pictures in computer-based instruction. However, Verdi et al. (1997) found that those who viewed a map before text performed better than those who were exposed to the text before map.

There are some factors that could have affected our results. The sample size was extremely small, and so the power of the data analyses was limited. Had the sample size been larger, significant results between conditions may have been found. Also these students were recruited from an upper level psychology class and so there was no control over their past exposure to the material taught (i.e. functional assessment). It is possible that some participants may have encountered functional assessment in another class during the course of this study. Furthermore the process of administering these methods and tests was conducted in a very short time, a one-week period. The results might have been different had the participants used the computer program and reading material for longer than one hour. Another concern was the participant's ability to use the computer program. A longer computer tutorial might have benefited some, for not all students have had the same amount of prior computer exposure.

Results from past research concerning instructional medium as well as the order of presentation are mixed. Additional research on computer based simulations and instructional combinations are needed in order to discover if one method consistently works better than the other. What combination of computer use, textual information, and lecture creates the best teaching strategy? Does a certain type of student benefit the most from computer use? Do students need a certain level of computer intelligence to benefit from these programs?

Each individual is different and may need a different instructional medium, or combination thereof to maximally benefit from instruction.

The answer to these questions is not simple. Effective teaching depends on a number of factors including the individual student, the subject matter, the teaching method used, and much more. Also we tend to learn better when we enjoy what we are learning. Sometimes this is not possible, however the learning experience can be made more enjoyable through the use of different mediums. For example, a monotone lecturer may leave the audience bored and unfocused where as a computer program with lots of colorful images may captivate and hold the attention of the audience. Even though we found no differences between instructional mediums, participants did rate SIDD higher than reading in effectiveness, perhaps because it was more enjoyable. We must continue to do research until consistent results are obtained in order to discover the optimal learning tactic for all.

Table 1

Mean and standard deviations for overall knowledge scores for conditions examining type (midtest) and order of presentation of instructional materials (posttest)

Condition	Pretest	Midtest	Posttest
Reading-SIDD	9 (2.73)	11.6 (1.6)	12.8 (2.87)
SIDD-Reading	8.7 (1.32)	11 (1.21)	10.5 (2.21)

Table 2

Mean perceived effectiveness of teaching objectives

	Conditions	
Objective	SIDD	Reading
Formulating behavioral definitions	3	2.5
Conducting functional assessment	1.6	2.5
Analyzing graphed data	1.64	2
Identifying functional hypotheses	1.9	3
Designing treatment programs	1.6	1.5

Table 3

Mean perceived usefulness of teaching objectives

Objective	Instructional Method SIDD	Reading
Provides practice in the application of behavioral principles and procedures	1.5	3
Teaches behavioral assessment skill	2	2.7
Teaches behavioral treatment skills	2	3

Figure 1

Overall knowledge pretest, midtest, and posttest scores for students in Reading-SIDD and SIDD-Reading Conditions.

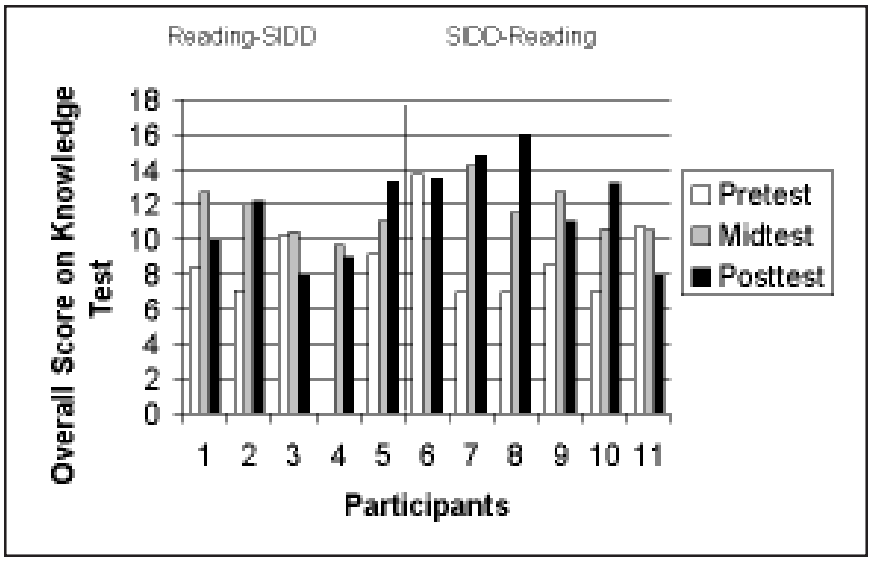


Figure 2

Overall definition pretest, midtest, and posttest score for students in Reading-SIDD and SIDD-Reading Conditions

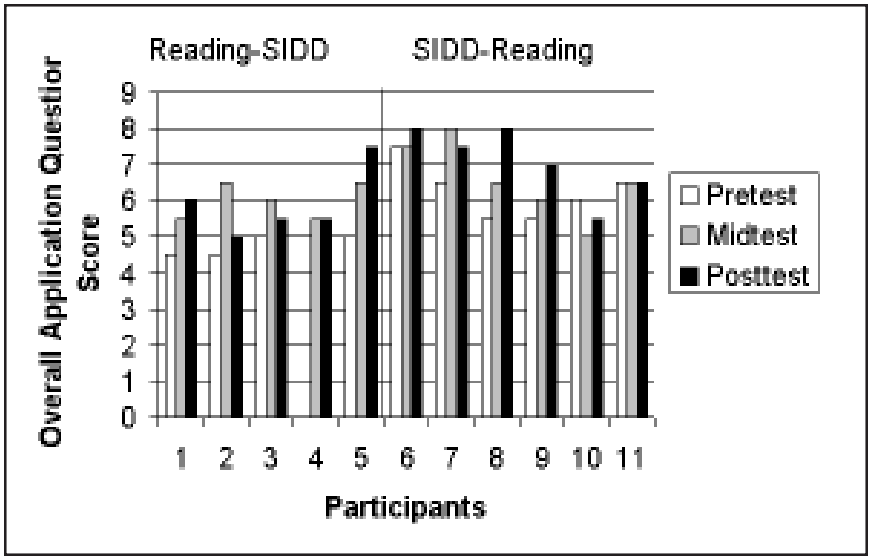


Figure 3

Overall application pretest, midtest, and posttest score for students in Reading-SIDD and SIDD-Reading Conditions

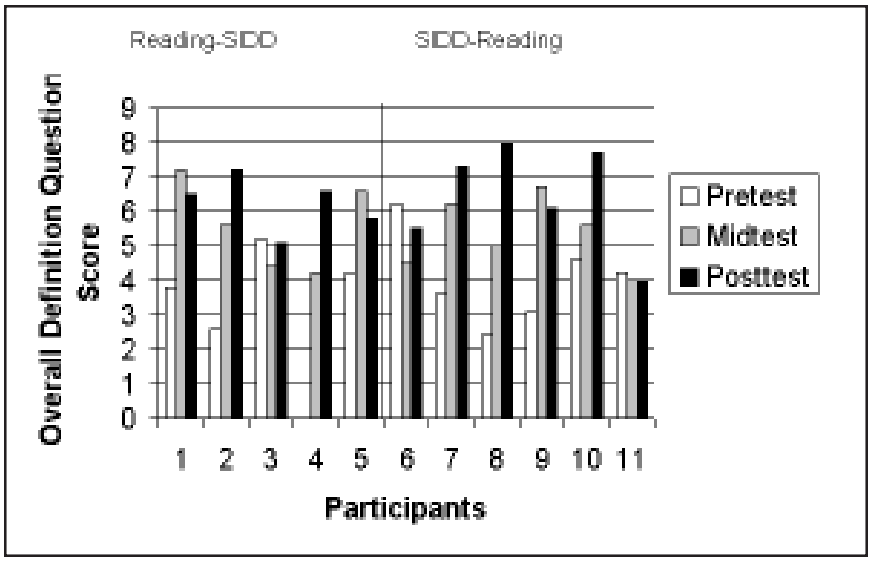


Figure 4

Overall open-ended pretest, midtest, and posttest score for students in Reading-SIDD and SIDD-Reading Conditions

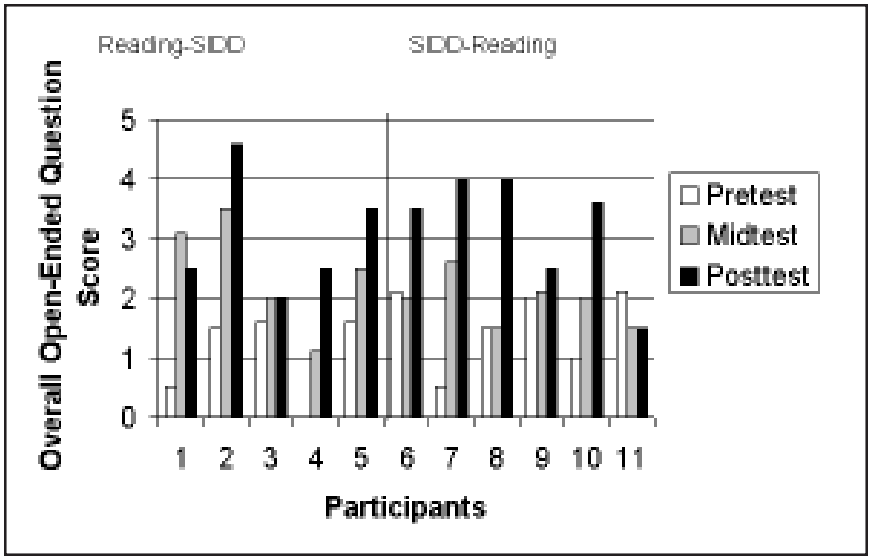


Figure 5

Overall multiple choice pretest, midtest, and posttest score for students in Reading-SIDD and SIDD-Reading Conditions.

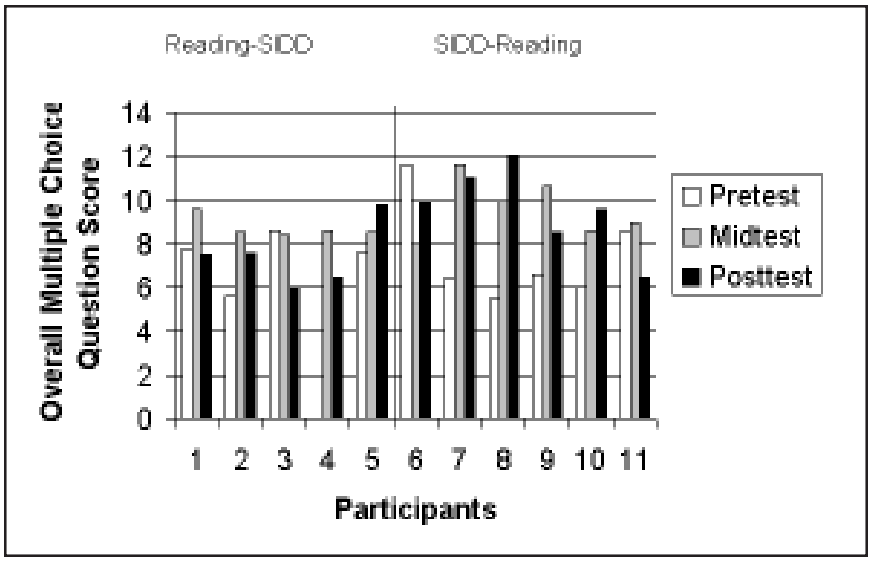
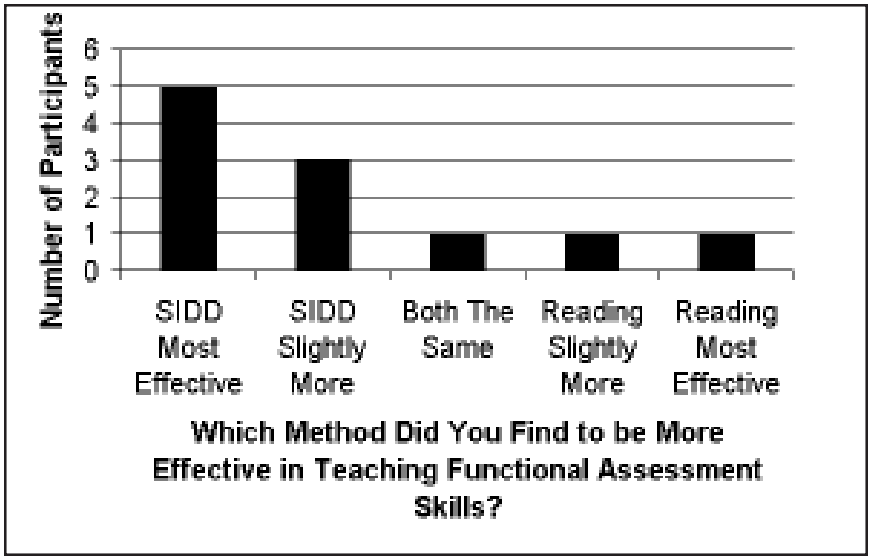


Figure 6
Student ratings of the most effective teaching method for teaching functional assessment



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