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ABSTRACT

Spatial context can be expected to play an important role in computer-based instruction and distance education using PC terminals because these types of computer-mediated instruction often occur in a restricted environment such as one's home or office. These settings, while convenient, are often isolated and lack diverse spatial cues. Fundamental research studies suggest this should result in negative effects for memory. This study investigated whether diversifying the setting in which computers are used as instructional tools would address this problem by creating more cues for retrieval of information. Participants (n=71) read three computer-based instructional units, each describing a different city. These city units were presented on a computer in a single site or in three diverse sites. The three learning sites were made more visually distinct on several dimensions, including decorative arrangements. All participants were tested for attribution recall at a new neutral site. Results confirmed the prediction that diversification of computerized learning sites improves recall, i.e., participants in the diversified learning sites performed better on the attribution memory test than students in a single learning site. Individual differences in sensitivity to background cues, as measured by the Group Embedded Figures Test, were not found to interact with test performance. (Author/MES)

Presentation Summary

Improved Attribution Recall from Diversification of Environmental Context During Computer-Based Instruction

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ABSTRACT

There is much evidence that spatial context is important to human information processing. For instance, memory for information is improved if it is learned in several rooms or from multiple sources, than in a single room or from a single source. Spatial context can be expected to play an important role in computer-based instruction and distance education using PC terminals, because these types of computer-mediated instruction often occur in a restricted environment such as one's home or office. These settings, while convenient, are often isolated and lack diverse spatial cues. Fundamental research studies suggest this should result in negative effects for memory.

This study investigated whether diversifying the setting in which computers are used as an instructional tool would address this problem by creating more cues for retrieval of information. Participants in the study (N = 71) read three computer-based instructional units, each describing a different city. These city units were presented on a computer in a single site or in three diverse sites. In the diversified condition, participants worked with different city texts in different sites. The three learning sites were made more visually distinct from each other on several dimensions including decorative arrangements. All participants were tested for attribution recall at a new neutral site.

The results confirmed the prediction that diversification of computerized learning site improves recall, i.e., participants in the diversified learning sites performed better on the attribution memory test than students in a single learning site. The main source of error was due to substitution error among the three city names. Furthermore, the type of attribute (unique to each city or shared among all cities) was found to interact with the treatment group (single or diverse). Individual differences in sensitivity to background cues, as measured by Group Embedded Figures Test, was not found to interact with test performance. The results were explained in terms of the diversified context elements providing extra cues for increased discrimination among cities or providing alternate memory paths for retrieving the attributive information.

Introduction

Technology-based education has come a long way, and recent years have seen a tremendous growth in the number of computer-based instructional programs. Now, students have the choice of using the Internet, interactive CD-ROMs, or distance education courses to supplement or replace traditional classroom instruction.

There are certainly advantages to such computer-based instruction. One is that education is accessible to more people. For instance, education is now more accessible to those who are disabled, live in rural areas, or have busy or uncertain work schedules. Students also have a greater control over their instruction, such as choosing the location and the hour at which they want to learn. They can learn at their own pace, starting or stopping the lesson any time and as often as they want. Feedback is quicker and can include reviews by peers as well as by the instructor. But most of all, computer-based instruction has the great advantage of convenience. Computer-based instruction, especially distance education, is convenient, because there is no longer a need to commute to a physical campus. Instead, students can receive instruction from their favorite chair at home or office.

But this vision of future educational setting is accompanied by another picture. Take the convenience of learning from home. With commuting to schools no longer a requirement, the student can spend most of the time receiving instruction alone in the same room day after day. Rothkopf (1972) has described such an environment as an electronic womb. While this is not true with all computer-based instruction, it is a real possibility with distance education courses. The question then arises as to whether such an electronic womb poses any problems for retrieval of what was learned. Results from studies on human cognition and learning suggest that this is the case.

Potential Problems with the Electronic Womb

The basis for suspecting a downside to having students learn from uniform setting day after day comes from research on context effect. We know that people encode more in memory than just what is taught. We encode both foreground information as well as the background information, such as objects, temperature, sound, etc. Specifically, our sense of place or location plays an important role on what we remember. For instance, people can often remember where they learned something, or where on a page they read something even if they were not required to do so. Furthermore, research studies have demonstrated that the more diverse the background cues, the better it is for memory.

Diversification Research

There are several well-known studies that have demonstrated the benefits of diversified learning sites on memory of ordinary instruction. In a study by Steven Smith (1982) study, students listened to four lists of words in one room or four different rooms. When tested for recall in a new room, those students who learned the lists in four rooms remembered more than those who had learned all the lists in one room. Smith and Rothkopf (1984) found similar results, using statistics lessons that were viewed in one classroom or four classrooms. They also gave students a Group Embedded Figures Test or GEFT as a measure of sensitivity to background context. They found that the score on the GEFT interacted with treatment, so that the benefits derived from the four-room condition was greater for high context sensitive (low GEFT score) students than for low context sensitive (high GEFT score) students.

In a study by Rothkopf, Fisher, and Billington (1982) students watched a debate among three speakers on one television monitor or three television monitors. In the three-monitor group, each monitor was associated with a different speaker. They found that the three-monitor group was better at attribution memory (recalling who said what) than the single-monitor group. Rothkopf, Dixon, and Billington

(1986) replicated the results using ordinary television program. Given the findings from these studies with non-computer-based instruction, the present study investigated whether the benefits of diverse learning sites would also hold under computer-based instruction. In addition, the study tested whether attribution memory would be improved by diversified computer-based instruction.

Procedure

The overall design of the study was comparing two groups of learners – students in a single learning site versus diversified learning sites. For the single group, students were presented with 3 text units on 1 computer in 1 learning site. For the diverse group, 3 text units were presented on 3 different computers in 3 different learning sites (see following page).

The text that the participants read was made up of cities and their attributes. Cities were chosen because they often contain parallel information that can later be confused. Two types of attributes made up the text about each city. Unique attributes are attributes that only appeared in one city, while shared attributes had similar information in all three cities.

The Group Embedded Figures Test was given to all participants to see if the interaction found by Smith & Rothkopf could be replicated. The test involved locating a simple shape within a complex line drawing. Participants were given 10 minutes to complete the 18-item test. Those who scored below the group median were designated as Low-GEFT, while those who scored above the group median were designated as High-GEFT.

Finally, an attribution recall test was given at a new location. There were 100 items, and participants were given 30 minutes to complete the test. A sample test question is "In which city was there a hotel that had a recent fire?"

PROCEDURE

1. Compared two groups of learners in single vs. diversified learning sites.

   N = 71

2. Single Group – read 3 text units on 1 computer in 1 learning site.

3. Diverse Group – read 3 text units on 3 different computers in 3 different learning sites.

	Diverse group	Single group
first text unit:	site 1	site 1
second text unit:	site 2	site 1
third text unit:	site 3	site 1

4. Text -

City Names	Rupelo	Selmer	Clemson
Attributes unique to each city	crime is low	transportation system is new	weather is harsh
Attributes shared among cities	Hotel 1 has big rooms	Hotel 2 had a recent fire	Hotel 3 has sculptures

PROCEDURE

5. Group Embedded Figures Test (GEFT)

   Find simple shape in complex line drawing

   18 items, 10 minutes

   Low-GEFT = below median

   High-GEFT = above median

6. An attribution recall test was given at a new site.

   "In which city was there a hotel that had a recent fire?"

   100 items, 30 minutes

Results

First, the overall results from the attribution test revealed that the diverse group had a mean score of 64% correct on the test, while the single group had the mean score of 50% correct. This difference in the mean scores was significant at .001. The errors for both groups were found to be substitution errors due to confusion among cities (see following page).

Next, I analyzed the results by the type of attributes contained in the text. Both groups combined had a mean of 64% correct on the unique attributes, while both groups had a mean score of 52% correct on the shared attributes. This difference was also significant. Thus, it seems that unique attributes were easier to recall. But what is more interesting is the interaction between group and the type of attribute. The interaction was significant as shown, indicating that there was a greater difference between unique and shared attributes for the diverse group than for the single group. This is shown in the graph. Thus, diversification has a different effect depending on the type of information to be recalled.

Finally, unlike the Smith & Rothkopf study, I found no interaction between group and the Group Embedded Figures Test. There are several possible reasons for the different findings of the two studies. First, Smith & Rothkopf did not give information in units as I did. In my study, information was organized into units and each unit clearly corresponded to a particular site. Second, in the Smith & Rothkopf study, students were run in groups in large classrooms, whereas in my study, students were run individually, sitting close to a computer monitor. Thus, all students in my study may have perceived or encoded similar level of the background context elements.

RESULTS

1. Attribution Test:

   Diverse group mean = 64% correct Single group mean = 50% correct

   $F(1, 70) = 23.50 \quad p < .001$

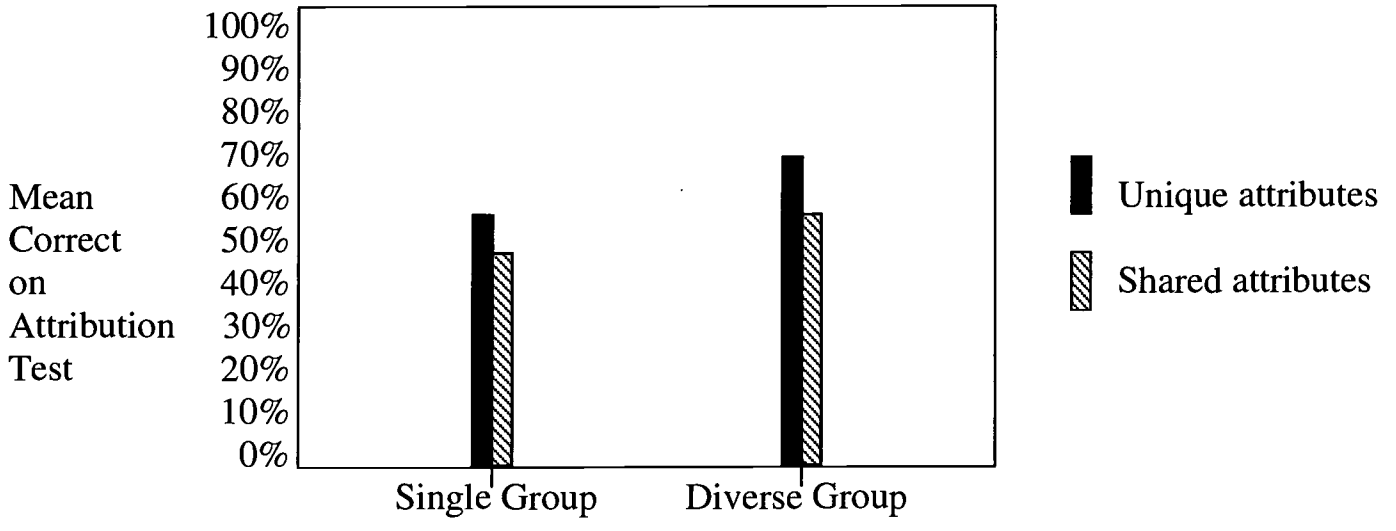
2. Unique attributes across groups = 64% correct

   Shared attributes across groups = 52% correct

   $F(1, 70) = 70.63 \quad p < .001$

3. Group (diverse or single) X Attribute (unique or shared) interaction =

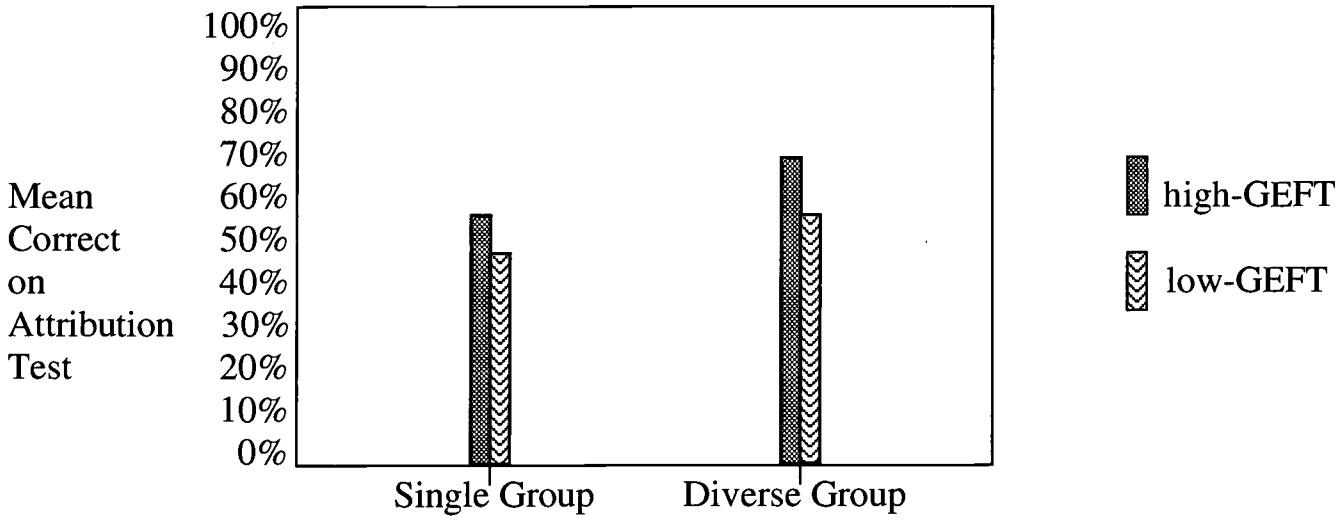
   $F(1, 70) = 6.67 \quad p < .01$



RESULTS

4. No interaction between group and the Group Embedded Figures Test

$F(1, 70) = 1.94 \quad p < .17$



Implications

Diversification may work in at least one of two ways. Diversified sites may reduce confusion among attributes because they provide an alternate, secondary path for retrieval from memory. This is like recalling what you had for lunch yesterday by first recalling where who you ate with. Diversification may also work by providing additional memory cues to distinguish information better.

With increased access to advanced technology, diversification may be achieved by using laptop computers that are more mobile, or by using flat screen televisions to project different context images onto a wall. Better yet, we can project images of the context in which students will later use the information for better transfer of knowledge.

Such options bring up the question of what we mean by having sense of a place. That is, do we have to believe that we are in a specific place, or it is enough to be told to think that they are different? Is it one specific element of a context or all the elements together that give us a sense of a place? Future studies will investigate these issues, using more completely computer-based instructional programs.

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