Investigating the Use of Advance Organizers as an Instructional Strategy for Web-based Distance Education

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Abstract
It is synthesized that advance organizers (AOs), an effective orienting device in traditional classroom instruction, may enhance students’ information literacy in self-directed online classes. The current study investigated the short-term and long-term effects of two types of advance organizers, graphic and text, in a fully Web-based undergraduate course on health care ethics. Although the results failed to yield a statistically significant difference regarding the use of AOs among treatment groups and the control group, additional qualitative data indicated that students held overwhelmingly positive attitudes towards using AOs, especially the concept map, in online learning. The analyses and results of this study added new empirical evidence for the use of AOs in Web-based distance education and posited new directions for further research.

In fully Web-based courses, the use of hyperlinked multimedia resources often bring challenges of cognitive overload and learner disorientation (Dias & Sousa, 1997). While the learners enjoy the flexibility and abundance of Internet resources, they may also be overwhelmed with multiple tasks and sources of information. As distant learners, the students cannot always obtain immediate feedback from instructors, and need to make decisions on their own to locate course materials and complete assignments. While they recognize hyperlinks as a method for accessing electronic resources and navigating online courses, these students are likely to experience greater difficulties than students in instructor-led, face-to-face classes in terms of navigation and guidance. To better exploit the capabilities of technology, the adoption of effective online teaching and learning strategies is suggested to resolve online learning challenges (Bonk & Dennen, 2003).

What kind of teaching and learning strategy exists for effective Web-based learning? Unfortunately, there is limited research to prove the effectiveness of learning strategies in fully Web-based environments. While many studies have shown no significant difference between online courses and traditional courses, applying traditional learning strategies at a distance often causes frustrations (Howell, Williams, & Lindsay, 2003). The literature reveals an increasing need to exploit research-based pedagogical strategies in fully Web-based environments.

Distance Education
Online learning has become pervasive in higher education. According to the latest survey, nearly two-thirds of all colleges and universities that deliver face-to-face instruction now offer online instruction, and the enrollment in 2004 in Web-based courses reached 2.35 million, up nearly 20% over the 2003 figures (Allen & Seaman, 2004, 2005).

Both students and instructors perceive that online learning provides major benefits. The biggest benefit is convenience. Students can access learning materials at virtually anytime and almost any place. Also, the Internet brings expanded resources to the learners at a very low cost. Recently, multi-media learning environments have been created with audio, video, graphic and animation to simulate true tasks which bring tremendous interests and motivation to learners. For the instructor, online teaching can also be beneficial in terms of structure and time, increased student outreach and contact, personal satisfaction, availability of expanded research tools, improved course management, and the ability to learn new technologies (Hartman, Dziuban, & Moskal, 2000).

At the University of Central Florida (UCF), online courses have become one of the major learning modalities. In the academic year of 2004-2005, 29,187 students, accounted for 65% of the total student population, were enrolled in the fully web-based classes (Center for Distributed Learning, 2006). Every semester, more than 180 online courses have been offered through WebCT, and currently there are 6 undergraduate programs online, 10 graduate programs online, and 10 graduate certificate programs online are available online. Although the Web has become an important instructional delivery mechanism, many students and faculty still fear self-directed learning processes and worry about the quality of online courses. Application of appropriate online instructional strategies is suggested to help students master course contents and to improve the quality and effectiveness of online courses.

Purpose
The current study investigated short-term and long-term effects of two kinds of AOs in a fully Web-based course. A concept map was used as a visual organizer, and an outline was used as a text organizer. Students’ knowledge acquisition and application were tested both immediately and four weeks after the instruction. All course
materials and assignments were accessed and completed on the Internet without any face-to-face instruction or meetings.

This study strengthens the connections between theory and educational practice by providing empirical evidence for the use of AOs in distance education based on cognitive learning theories.

Specifically, this study is designed to explore one instructional strategy, the use of AOs, to promote information literacy in a fully web-based distance course. Two hypotheses were posited for this study.

Null hypothesis I. There is no difference in the short-term knowledge-based and performance-based learning achievements among students in the concept map, outline and control groups.

Null hypothesis II. There is no difference in the long-term knowledge-based and performance-based learning achievements among students in the concept map, outline and control groups.

Foundations

Theoretical Foundation

The rationale for using advance organizers (AOs) is rooted in cognitive learning theories. Cognitive theories claim that learning depends on processing capacity and prior knowledge (Driscoll, 1999). With the aid of AOs, learners are able to link what they already know to new information and apply it to new context.

Ausubel (1968) first introduced the concept of AOs in his assimilation theory of meaningful learning and retention. Like other cognitive theorists, Ausubel asserted that learning is based on schemata or mental structures by which students organize their perceived environment. Ausubel suggested that AOs help students activate prior knowledge in the new instructional context and make the instructional process meaningful to the students (Ausubel, 2000). His early experiments provided the most-cited research supporting the effectiveness of AOs with increasing achievement (Ausubel, 1960; Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963).

Mayer reinterpreted Ausubel’s use of AOs in terms of his assimilation encoding theory (Mayer, 1979a). He indicated that the successful use of AOs is highly influenced by the availability of an assimilative context in memory and the active use of knowledge during learning. He reported the results of a series of nine studies and also examined 27 AOs studies conducted by other researchers in the 1960s and 1970s (Mayer, 1979a, 1979b). The results supported his contention that AOs will facilitate learning in situations where learners do not possess a rich set of relevant past experiences and can actively integrate the AOs in the new context.

Based on neurophysiological science, the recent brain-based learning research also supports the idea of meaningful learning and active processing. It is asserted that meaning is more important than information and active information processing is strongly connected to prior learning (Caine & Caine, 1991). The brain-based learning theories also imply that the teacher needs to prepare the students before a unit of study to attach new information to prior knowledge so the new information has something to “latch onto” (Jensen, 1996). In addition, empirical studies support many of the proposition regarding AOs and learning posed by various theories.

Empirical Evidence

Extensive research was conducted on the effectiveness of using AOs in classroom teaching from the 1960s to the 1990s. The research evidence concerning any facilitative effect of AOs upon learning and retention is variable, but positive in general. Although Ausubel’s early experiments supported the effectiveness of AOs with significant increasing learning achievement (Ausubel, 1960; Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963), later studies failed to show a consistent positive facilitative effect (Barnes & Clawson, 1975; Luiten, Ames, & Ackerson, 1980; Mayer, 1979b; Stone, 1983). The discrepancies regarding the effectiveness of AOs might result from inadequate construction of AOs or weak research procedures or control (Kenny, 1993; Luiten et al., 1980; Mayer, 1979b).

In the 1990s and 2000s, AOs still remained an actively debated topic. Research on the traditional AOs drastically decreased in number possibly due to the non-statistical-significance of the research results. However, many researchers began to conduct studies on AOs in a variety of formats, such as visual AOs (DaRos & Onwuegbuzie, 1999; Herron, Hanley, & Cole, 1995; Hirumi & Bowers, 1991; Millet, 2000) and multimedia AOs (Calandra, Lang, & Barron, 2002; Hale, 2003; Minchin Jr., 2004; Tseng, Wang, Lin, & Hung, 2002; Yeh & Lehman, 2001). Consistent with the historical findings, recent research again failed to generate statistically significant results on effectiveness of AOs on posttest scores between treatment groups and control groups, though most researchers continued to suggest a mild but positive effect of AOs on learning and retention.

The statistical non-significance of the research might be attributed to imprecise construction of organizers, short duration of treatment, inadequate research control, and insufficient instruction on how to use organizers (Kenny, 1993; Luiten et al., 1980; Mayer, 1979b). Synthesizing the findings of recent research on AOs, the current study is an attempt to:
1. investigate AOs as a helpful orienting device not only in the context of computer-assisted instruction, but also in the online learning environment.
2. test different types of AOs, including graphic, graphic + text, and multimedia instructional organizers.

Method

Subject

Participants of this study were selected from a population of undergraduate students enrolled in a fully Web-based health class at the University of Central Florida. This course was a health related ethics course. It was required for all health-related major undergraduate students. The course was fully Web-based, requiring no face-to-face meetings, where the instructor and students logged into a WebCT account and communicated through course pages, discussions and e-mails within the online account. The course covered ethical issues in health care, including life-saving measures, rights to die, transplants, surrogate parenthood, privacy and confidentiality, and decision-making.

The population encompassed 164 undergraduate students enrolled in a fully web-based class. The majority of the students were between the age of 21-23 in either their junior or senior year. Most students were health-related majors. Three fourths of the participants were female students, and most of the students are white Caucasians. Al enrolled students were asked to participate in this study on a voluntary basis. Bonus points towards the course credit were awarded for participants who completed all instruments. Almost 80% of the class voluntarily participated in the study activities, and 63 of the 164 course participants completed both quizzes and a survey.

Research Design

This study used a repeated-measure, control-group posttest-only design with random assignment to examine the effects of advance organizers (AOs) on learning as illustrated in Figure 1.

```
   R  E1       X1 (Graphic Organizer)  O1  O2
   R  E2       X2 (Text Organizer)    O3  O4
   R  C        (No Advance Organizer) O5  O6
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Figure 1. Research Design Diagram

“R” indicated that all participants were randomly assigned to three groups, two treatment groups (E1 and E2) and one control group (C). AOs were the intervention in this experimental event. The experimental group (E1) reviewed a concept map, a form of graphic organizer, before reading textbook. The comparison group (E2) reviewed a text organizer, and the control group (C) did not read any AO before textbook reading. During the course of the study, all three groups completed an immediate posttest (O1, O3, and O5) and a delayed posttest (O2, O4, and O6).

Dependent & Independent Variables

The dependent variable in this study is students’ learning achievement, encompassing their short-term (O1, O3, and O5) and long-term knowledge acquisition and application (O2, O4, and O6). The short-term and long-term knowledge acquisition was tested with two corresponding 12-item knowledge quizzes. The short-term knowledge application was tested with problem-based scenario essay questions.

The independent variable is the treatment of AOs (X1 & X2). The three groups had the same instruction, except for the treatment of AOs. The experimental group used a concept map (X1); the comparison group used a textual outline (X2); and the control group had no AOs exposure before textbook reading.

A posttest I-posttest II repeated-measure design was exploited in this study, and time was another independent variable for the research. It is assumed that the time factor might influence students’ learning achievement over a period of four weeks’ time.

Advance Organizers

Two forms of AOs were designed respectively for the experimental and comparison groups. The construction of the AOs was based on the criteria prescribed by Mayer (1979b) and followed a series of research-based procedures (Bricker, 1989; West, Farmer, & Wolff, 1991). Students were instructed to review the AOs before they read the textbook. Figure 2 and Figure 3 illustrate the AOs used in the study.
The graphic organizer is a flash-based interactive concept map as illustrated in Figure 2. The text organizer presents the same concepts and explanation as the concept map, as illustrated in Figure 3. Both AOs are linked to the instruction page of module 2. The only difference between the two organizers is the presentation of the relationship among the concepts. The concept map illustrates the relationship visually in a nonlinear way, and the textual outline presents it textually in a linear way. The validity of these AOs was tested and confirmed by expert review from both the instructor and the outside instructional designer, and modifications were made based on their suggestions.

**Procedures**

This study lasted for six weeks. During the first week of the spring semester, 2006, participants were randomly assigned into three groups. Each group was provided with one version of module 2 during week two. In the course module, the students were suggested to first review the advance organizers (AOs) to have an overall idea of the key concepts and issues covered in this module, if they had one available in their group. The students in the experimental group reviewed the multimedia concept map before reading the book. The students in the comparison
group reviewed the text outline before reading the book. The students in the control group were not given an AO, and they proceeded directly to textbook reading.

Chapter 2, “The Physician-Patient Relationship” of the textbook, Biomedical Ethics (Mappes & Degrazia, 2005), was the designated reading materials. After textbook reading, the students were instructed to complete all the assignments on the assignment page, including the two parts of the posttest I. The knowledge quiz of posttest I was a timed WebCT quiz. The students had 15 minutes to complete the 12 questions and they could only access and submit the quiz once. However, as this was a fully Web-based course, the quiz was not proctored and students had the flexibility to do the quiz at their convenience during the instruction week. For the second part of posttest II, the students completed three questions based on a scenario using Microsoft Word and submitted the assignment to the WebCT Dropbox tool by the next Monday morning. Also during this week, students filled out an online survey to report their background information and their uses of AOs.

Four weeks after module 2, in week six, posttest II was administered through WebCT. Together with all the other assignments for module 6, posttest II, including a quiz and three scenario questions, was open for the students. It was stated in module 6 that both the quiz and scenario questions of posttest II were part of the voluntary research. The students completed this posttest with the knowledge they had learned in module 2.

Research Findings

Statistics procedures, including descriptive analysis, one-way analysis of variance (ANOVA), and repeated-measure regression were performed to study the research findings.

Descriptive analysis was used for scores in the posttests. Means, standard deviations, and effect sizes of students’ achievement scores were computed for each quiz and scenario questions of posttest I and II. The assumptions of the analysis, including the homogeneity of variance and the normality of population distributions, were examined using the Levene’s test and the Q-Q plot procedures. Detailed descriptive statistics of the students’ learning outcomes are illustrated in Table 1 and Table 3 in the next sections under the discussions of research hypotheses.

Null Hypothesis I: There is no difference in the short-term knowledge-based and performance-based learning achievements among students in the concept map, outline and control groups.

In posttest I, students of group 1 using a concept map had the highest mean score (36.25) in the knowledge quiz 1, compared with those of the other two groups. In the performance-based scenario questions, there was little difference in the mean scores of the three groups. Table 1 illustrates the detailed means and standard deviations of students’ learning outcomes in posttest I.

Table 1 Means and Std. Deviations of Posttest I Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Full Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36.25</td>
</tr>
<tr>
<td>2</td>
<td>32.67</td>
</tr>
<tr>
<td>3</td>
<td>33.89</td>
</tr>
<tr>
<td>Total</td>
<td>34.15</td>
</tr>
</tbody>
</table>

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<td>33.89</td>
</tr>
<tr>
<td>Total</td>
<td>34.15</td>
</tr>
</tbody>
</table>

Note: Group 1—Experimental group with concept map; Group 2—Comparison group with outline; Group 3—Control group.

To test hypothesis I, ANOVA was used to compare the mean scores of posttest I of the three groups. Null hypothesis I suggests that students who were exposed to a concept map AO or an outline AO would show no difference, in both the short-term knowledge-based and performance-based learning achievements, from those who were not exposed to an AO. Table 2 shows that there is no statistically significant difference among the three groups in either the knowledge quiz ($F_{2, 122} = 1.130, \alpha > 0.05$) or the performance scenario questions ($F_{2, 137} = 0.412, \alpha > 0.05$). Also, the effect sizes for AOs in both tests are relatively low. Only 1.8% of the differences in quiz 1 scores can be explained by the treatments of AO among the groups. Less than 1% of the difference in scenario 1 scores can be explained by the use of AO.

Table 2 Tests of Between-Subject Effects in Posttest I

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz 1</td>
<td>255.452</td>
<td>2</td>
<td>127.726</td>
<td>1.130</td>
<td>.327</td>
<td>.018</td>
</tr>
<tr>
<td>Scenario 1</td>
<td>63.326</td>
<td>2</td>
<td>31.663</td>
<td>.412</td>
<td>.664</td>
<td>.009</td>
</tr>
</tbody>
</table>
Null Hypothesis II: There is no difference in the long-term knowledge-based and performance-based learning achievements among students in the concept map, outline and control groups.

In posttest II, there are little variations in the mean scores in either quiz 2 or scenario 2 questions. The control group outscored the AO treatment groups by less than 1 point in both tests. Table 3 shows the means and standard deviations of the students’ learning outcomes in the delayed posttest.

Table 3 Means and Std. Deviations of Posttest I Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Quiz 2 Mean</th>
<th>Quiz 2 Std Deviation</th>
<th>Scenario 2 Mean</th>
<th>Scenario 2 Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.04</td>
<td>11.32</td>
<td>23.29</td>
<td>3.62</td>
</tr>
<tr>
<td>2</td>
<td>30.95</td>
<td>6.86</td>
<td>22.23</td>
<td>5.57</td>
</tr>
<tr>
<td>3</td>
<td>30.76</td>
<td>8.40</td>
<td>24.10</td>
<td>2.77</td>
</tr>
<tr>
<td>Total</td>
<td>30.36</td>
<td>8.71</td>
<td>23.17</td>
<td>4.21</td>
</tr>
</tbody>
</table>

Note: Group 1—Experimental group with concept map; Group 2—Comparison group with outline; Group 3—Control group.

Similar to the findings in the short-term learning achievement posttest I, the difference in posttest II is not statistically significant in either the knowledge-based quiz (F2, 95= 0.412, α>0.05) or the performance-based scenario questions (F2, 60= 1.051, α>0.05). The effect size of AO in quiz 2 is below 1%. The effect size of AO in scenario questions 2 is 3.4%, far below 20% which is indicative of a small effect by the Cohen’s convention.

Table 4 Tests of Between-Subject Effects in Posttest II

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz 2</td>
<td>63.326</td>
<td>2</td>
<td>31.663</td>
<td>.412</td>
<td>.664</td>
<td>.009</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>37.13</td>
<td>2</td>
<td>18.565</td>
<td>1.051</td>
<td>.356</td>
<td>.034</td>
</tr>
</tbody>
</table>

Additional Analyses

During the study, students were given the opportunity to fill out a survey about their online learning experience, especially their attitudes towards using AOs. 130 students from the three groups completed this survey. Table 5 shows the students’ experience using AOs in the treatment groups. Approximately half of the respondents in the concept map group indicated that they spent 6-10 minutes reading the concept map, and they read it twice. Approximately half of the respondents in the outline group reported that they spent 1-5 minutes reading the text outline, and they read it once. The majority of the respondents in both groups agreed that using advance organizers was helpful for them.

Table 5 Survey on Students’ Experience with Using AOs

<table>
<thead>
<tr>
<th>Concept Map</th>
<th>Text Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time spent on AO</td>
<td>6-10 min</td>
</tr>
<tr>
<td>How many times read AO</td>
<td>Twice</td>
</tr>
<tr>
<td>When read</td>
<td>Before textbook</td>
</tr>
<tr>
<td>Usefulness</td>
<td>Agree</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
</tr>
</tbody>
</table>

Discussions

Neither of the null hypotheses failed to be rejected in this study on using advance organizers (AOs) in Web-based distance education. The research findings indicate that there is no difference in either the short-term or long-term learning achievements among students in the concept map, outline and control groups.

According to Ausubel’s assimilation theory, students given AOs should perform better on tests on the material-to-be-learned than students in control groups (Ausubel, 1968). In the current study, students in the concept-map group outscored the other groups by 3-4 points out of a full 60 points by average in the immediate knowledge quiz (posttest I). The difference in performance-based scenario questions was slight among the three groups. The full score for the scenario questions was 25, and the mean scores for all of the groups were around 22.5, indicating a ceiling effect that the assessment instrument may lack sensitivity and discrimination in measuring learning outcomes. The control group scored at an average of 22.28 out of 25 on the scenario questions. There was
less than 3 points (12%) of improvements for the treatment groups to achieve. Similar to the historical studies on AOs in face-to-face classes, no statistically significant difference was found in either the knowledge-based or the performance-based tests in this Web-based AO study.

It is speculated that the AO effect should be greater in longer studies, especially in the ones over 10 days, than in shorter ones (Ausubel, 1968; Luiten et al., 1980; Stone, 1983). However, this study failed to prove a greater AO effect on students’ learning achievements in a delayed posttest (posttest II) four weeks after the AO intervention. The differences in both the knowledge-based and the performance-based tests were slight, and the effect sizes were considered to be small and below 0.05 by the Cohen’s convention. Similar to posttest I, a lack of differentiation might be one of the reasons that attribute to the non-significant result in posttest II. Also, in the posttest, students reported a shortage of time during the quiz, and over 50% of the students made errors in the last two quiz questions. Therefore, speeding effect might be another factor that seriously affect the measuring error of the quiz instrument.

In combination with the AO effects, this study examined other factors that might influence students’ learning achievements using repeated-measure analysis of covariance (ANCOVA). The results show two statistically significant factors: time between posttests and weekly study time. There is a statistically significant time effect (F1,42=13.185, p<.01) on students’ learning outcome. Almost 13% of the variance in scores can be explained by the time elapsed between the two posttests. This indicates that students’ test scores were considerably lower in the delayed posttest II compared with the immediate posttest I, with an elapse of four weeks’ time. Also, weekly study time has a statistically significant effect on students’ learning achievement (F1,42=6.165, p<.05). Almost 13% of the variance in scores can be explained by the weekly study time. This suggests that the more time students had reported as learning time, the better they would perform in the posttests. Other factors were examined without statistical significant effect. They are GPA scores, technical abilities, pretest scores, Web-based learning experience, age, and class standing.

Most of the students found using AOs, especially the concept map, helped them scaffold the learning materials. Their feedbacks in the survey indicated how they used AOs in learning. The majority of the students would read AOs before they read the textbook. They spent, on average, 6-10 minutes reading the concept map, and would usually refer back to the concept map during or after they read the textbook. For the text outline, the student would spend 1-5 minutes reading, and read it only once. According to the survey results, this study successfully demonstrated how AOs could be integrated in Web-based distance learning, and the concept map was better received by the students compared with the text outline.

Conclusions

Web-based distance learning is becoming an important trend in the higher educational settings. More and more instructors and students choose online classes to take advantage of the time and location convenience. It has always been a challenge to examine the effects of pedagogical strategies in a fully Web-based environment. The current study investigated the use of advance organizers (AOs) in a fully Web-based health care ethics course. Consistent with results of the studies in the traditional classes, this study failed to show a statistically significant short-term or long-term effect of AOs on knowledge-based or performance-based learning achievements. Also, this study failed to determine which format of AOs (graphic or text) better facilitate students’ learning achievement. However, students showed positive attitudes towards using AOs in online learning and they reported that the use of AO helped them break down the course contents and highlighted the important concepts.

The failure to generate a statistical significance might be due to several reasons. One of the issues that the researcher had found in the study is that it is impossible for an online quiz to be monitored. Though the quizzes had been instructed as close-book tests, it was possible that students still referred to their lecture notes and the textbook while they answered the quizzes. This might seriously weaken the validity of the quiz instruments. An important implication for further research is to develop measures to prevent students from referring to other assistant materials in self-directed online quizzes. Another reason for the non-significant result might be the lack of discrimination of the scenario questions in measuring students’ analytical and critical thinking abilities. Future studies need to develop more strict rubrics to differentiate students’ learning outcomes in the assessment instruments. Also, the limited intervention length might be an important factor that influences the effectiveness of AO. The current AO intervention was used in a one-week module. For future studies, it might lead to statistically significant results if the AO strategy is integrated in a whole semester-long course and the AO effect is tested on a course level.

This research shows that instructional strategies, like advance organizers, can be incorporated into online learning experience. It has been assumed by many researchers that the adoption of effective online teaching and learning strategies is a solution to learning challenges in an interactive multimedia environment. This investigation can be served as an example for future studies on how to design, implement, evaluate, and disseminate empirical research result on the effectiveness of instructional strategies in Web-based distance education.
References


