An Investigation of the Effect of Web-assisted Learning on Students’ Academic Achievement and Attitudes

Hesham Alomyan,
Faculty of Arts and Sciences,
University of Petra, Jordan.
E-mail: halomyan@uop.edu.au

Greg Yates,
School of Education,
University of South Australia, Australia.
E-mail: Gregory.Yates@unisa.edu.au

Abstract

This paper reports on a study conducted to investigate the effect of the use of Web-assisted learning package as an adjunct to an ongoing university lecture course, on students’ learning and to measure their attitudes towards Web-assisted learning. The findings showed that students who used the package and the traditional lectures outperformed significantly those who used only the traditional lectures. In addition, the students who used the package showed high positive attitudes towards Web-assisted learning. That is, the majority of the students found that Web-assisted learning was a convenient environment for learning as it allowed them to control the pace of their learning and gave them more opportunities for learning. Finally, the study concluded that students benefit from a mixed model where traditional instruction is supplemented with online learning, and suggested effective instructional strategies that can be used in Web-assisted learning systems.

Key Words: Web-assisted learning, instructional strategies, learning design
1. Introduction

The rapid advancements in the Internet technologies especially the Web have captured the attention and interest of educators and instructional designers around the world, to look for ways to use the Web effectively in teaching and learning. Two methods of using the Web for educational purposes can be seen in higher education: Web-assisted and Web-based learning. Web-assisted learning is the use of the Web to support the traditional forms of instruction (also called blended learning). Web-based learning uses the Web as the sole delivery system. That is, learners are not able to complete the subject without having regular access to the Web and there is no class attendance or face-to-face meeting required.

Web-assisted learning combines the strengths of both Web-based and traditional teaching methods and supports traditional education processes via internet technologies. The main advantage of using the Web as a supportive tool for traditional method of instruction lies in its flexibility, allowing students to access content anytime anywhere. That is, it encourages learning self-management and sustains students’ interest in learning and engages them as active learners. It compensates for the lack of social interaction, identified as the main disadvantage of the Web-based learning (Heinze & Proctor, 2006). Research examining whether the Web-assisted learning contributes to students’ academic success and sustain interest in learning is minimal. Therefore, the purpose of the present study is to determine the effect of Web-assisted learning on students’ academic success and attitudes.

2. Literature Review

Research investigating the use of the Web in education shows that online stand-alone courses do not satisfy students and that there are certain deficiencies, especially the lack of face-to-face interaction (Bonk & Graham, 2005). Recent studies suggest that in addition to face-to-face interaction in the traditional mode of delivering instruction, Web-assisted delivery of instruction provides interaction between peers and faculty through emails, chat rooms and discussion boards (Stocks & Freddolino, 2000; Van Soest, Canon, & Grant, 2000), and enhances student satisfaction by creating enthusiasm for assignments and participation (Frey, Yankelov, & Faul, 2003; Wernet, Olliges, & Delicath, 2000). Van Soest et al (2000) reported that Web-assisted learning offered a useful device for students to discuss sensitive issues they might otherwise have been reluctant to discuss in class. In addition, learner control over the time and place to receive instruction is often perceived as a primary advantage of Web-assisted learning.

Despite the advantages of Web-assisted learning, much of the literature addressing Web-assisted learning has focused on student’s satisfaction (e.g., Frey et al., 2003; Petracchi & Patchner, 2000; Rudolph & Krause, 2002; Stocks & Freddolino, 2000; Van Soest et al., 2000; Cheng, 2011; Liu, Liao & Pratt, 2009) and only expressed concern about the effectiveness of
Web-assisted learning (Turkcapar, 2015; Thyer, Artelt, Markward, & Dozier, 1998). That is, little research has been conducted on the efficacy of this method of instruction and much of the research available has shown inconclusive results. Therefore, the present study is an attempt to examine the effectiveness of Web-assisted learning to shape best practice guidelines for educators and designers to develop effective Web-assisted learning packages.

3. Overview of the Study

The aim of the present study was to investigate the effect of the use of Web-assisted learning on student learning. An opportunity arose to use a Web-assisted learning package as an adjunct to an ongoing lecture course in the School of Education, University of South Australia. Students elected to use this online package in addition to their traditional lecture and traditional reading material. The package was developed to supplement the other traditional material and afford students with additional opportunities to organise the content of the course. Details on the Web-assisted package are provided in the instruments section. Another aim of the study is to measure students’ attitudes towards using the Web in learning.

4. Research Questions

The present study was undertaken to answer the following research questions.

1. Will students who use the Web-assisted learning package perform better than students who do not use the package?
2. What are the students’ attitudes towards Web-assisted learning?

5. Hypotheses of the Study

Based on the research questions the following hypotheses were advanced.

*Hypothesis one:* Students who use the Web-assisted learning package will exhibit enhanced scores on the examination measures.

*Hypothesis two:* Students who used the Web-assisted learning package will show positive attitudes towards using the Web in learning.

6. Participants

The participants of the study were second-year university students in the School of Education, University of South Australia, enrolled in Educational Psychology 2 as part of the compulsory core within a teacher education award. The participants were 71 students. The sample consisted of 57 females and 14 males. These participants were labelled as “package participants” (PP, students who participated in using the Web-assisted learning package). Additional data from 138 other students in the same course were available from course assessments. These 138 students then served as a type of non-treatment control group and this group was labelled as “non package students” (NPS, students who did not use the package). The NPS sample consisted of 112 females and 26 males. The ages of the students were ranged between 19 and 30 years old.
It must be noted that there are slight variations in the number of participants who undertook the surveys and achievement tests, due to several individuals producing incomplete data.

7. Treatment Instrument (Web-assisted Learning Package)

A Web-assisted learning package was developed as a supplementary online resource for the course entitled ‘Educational Psychology 2’ offered to second year undergraduate students in the School of Education, University of South Australia.

The development of the Web-assisted learning package went through three phases;

7.1 Locating the Learning Material

The learning materials of the package were chosen from the Educational Psychology 2 course. Two topics of the course were selected to be for the package: (a) psychology of science, and (b) psychology of reading and writing. Each topic represented a module accounting for one-week of a 12-week course. The topics were then studied by the present researcher. The main concepts and sub-concepts in the topics were identified and a summary on each concept were provided. The learning material was then checked by the course coordinator of the Educational Psychology 2 and the present research supervisors. After all the parties were satisfied with the organisation of the learning materials, the learning materials were then saved in a Word document file.

7.2 Designing the Online Package

The online package was developed by taking the following design considerations into account: (a) organising the course content using concept maps; and (b) providing navigation support by using path indicators.

**Concept maps:** Once the concepts and sub-concepts of the learning material were identified, Inspiration software was used to present these concepts visually. Having done that, Dreamweaver was used to create the Web pages of the package. Each page was divided into two main areas: A navigation area and a content area. The concept maps were exported from Inspiration into Dreamweaver and inserted in the content area. The concept maps in the content area acted as both a navigational tool and a presentational tool for the course content. The concept maps were clickable and consisted of nodes representing concepts connected by directional links that define the relationships of the nodes and provide further information on each concept.

**Path indicators:** Path indicators were used to orient users to the surrounding hyperspace and to the content organisation. In the present design the path indicator presented the current, previous and next topic. The path indicator appeared at the top of each page and illustrated clearly the local neighbourhood of a topic.

**Screen arrangement.** As shown in Figure 1, the computer screen was divided into two main areas: A navigation area and a content area. In the navigation area two types of navigation links
were used, textual navigational links which appeared in a panel on the left side of the screen and graphical navigational links which appeared at the bottom of the screen. These links were separated from the information presentation and appeared permanently on all pages of the Website. The purpose of using these two types of links was to meet preferences of some students who were inclined to textual index and those who preferred to use visual links. In addition to these links, for ease of navigation, there was a textual path indicator at the top of each Webpage.

As for the content area, the content was presented relatively in the middle of the screen with two parts, upper and lower. The upper part was assigned for concept maps and the lower part was used to present the hypermedia document, which has detailed information on each concept. Concept maps were used to provide a general overview of the content including main topics and subordinate topics in a hierarchical manner so that the learner can develop an understanding of the topics to be learnt and of the sequence of individual sections of the subject matter.

Rationale of the design. The rationale of designing the package was founded on the theory of meaningful learning (Ausubel, 1968) and cognitive load theory (Sweller, 1994). According to the cognitive load theory, strategies should be used to allow learners to perceive and attend to the information so that it can be easily transferred to the working memory (Chandler & Sweller, 1991). Placing important information in the centre of the screen and presenting information in small chunks are some techniques could be used to prevent overload during processing in the working memory. On the other hand, to be recalled from the long-term memory, according to the cognitive theory, information must be activated to make sense of the new information. Advance organisers and concept maps can be used to facilitate the retention and use of existing schema (Ausubel, 1968; Novak, 1976). Advance organizers could also be used to link what the learner already knows with what is being learnt. Concept maps are an effective strategy for providing the “big picture” to learners, to help them comprehend the details of a lesson and in turn facilitate deep processing.
7.3 Implementing and Testing the Online Package

Once all the learning materials were compiled and migrated into the Web pages created in Dreamweaver, curriculum developers, teaching staff, and colleagues were invited to check the Web-assisted learning package conceptually and technically. Based on feedback from the invited people, the package underwent further refinement. The package was then put onto the School of Education server. Further technical testing was carried out to ensure that the package was working as it should be before it was introduced to the students.

8. Measurement Instrument

Two instruments were employed in the present study to measure learning outcomes and attitudes. These instruments included:

- A 6-item Attitude Scale was adapted from Shih (1998).
- The final examination scores of the two online topics (i.e., science, reading and writing) were used as a measure of learning outcomes.

These instruments will be further discussed in the following sections.

8.1 Student Attitude Scale (SAS)

The Student Attitude Scale was an online survey consisting of 6 items adapted from a questionnaire used in Shih’s (1998) study on assessing biology students’ attitudes towards
Web-based learning. The five-point Likert-type scales had response options ranging from (1) Strong Disagree to (5) Strong Agree.

A factor analysis was conducted on the items. As shown in Table 1, the 6 items loaded strongly on one factor. The items were subjected to an SPSS Reliability procedure. The analysis revealed that all the items combined to form a coherent scale (i.e., attitude to Web-based learning) with an internal alpha reliability coefficient of 0.82. Table 2 shows the psychometric properties of the scale. See Figure 2 for a graphical display of the distribution of the items scores.

Table 1: Factor Loadings for Student Attitude towards Web-based Learning

<table>
<thead>
<tr>
<th>Attitude items</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoy learning from Web-assisted learning</td>
<td>.88</td>
</tr>
<tr>
<td>I will recommend Web-assisted learning to my friends</td>
<td>.87</td>
</tr>
<tr>
<td>The Web should be utilized more often to deliver instruction</td>
<td>.74</td>
</tr>
<tr>
<td>Learning through the Web is convenient</td>
<td>.72</td>
</tr>
<tr>
<td>Web-assisted learning allows me to control the pace of my learning</td>
<td>.68</td>
</tr>
<tr>
<td>Web-assisted learning provides me with learning opportunities that I otherwise would not have had</td>
<td>.58</td>
</tr>
</tbody>
</table>

Note. Reported loadings are based upon principal components analysis.

Table 2: Descriptive Properties of the Student Attitude Scale

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>50</td>
</tr>
<tr>
<td>Mean</td>
<td>21.5</td>
</tr>
<tr>
<td>Median</td>
<td>21</td>
</tr>
<tr>
<td>Mode</td>
<td>24</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>3.8</td>
</tr>
<tr>
<td>Skewness</td>
<td>.27</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-.43</td>
</tr>
</tbody>
</table>
9. Procedures

Web-assisted Learning Package. After obtaining permission from the course coordinator for participation of the students in the study, the Web-assisted learning package was offered to all students of Educational Psychology 2. The package was placed on the School of Education Server after. Students were notified about the package firstly during the lecture and secondly via the University email facility. These messages indicated that the adjunct Web-assisted learning material was available should they wish to log on.

Attitude survey: As part of the online package there was a survey students were asked to take; the attitude survey. Students who chose to use the package were initially given access to the study material. Following on studying the material, the students were asked to complete the attitude survey. Students were given a period of two weeks to use the package prior to their final examination. The final examination was of a traditional paper-based format. The items consisted of short answers, multiple-choice, and true-false questions. After the period was over, the students participated in the final examination. Scores of the two sections (i.e., science, reading and writing which constituted the learning package material) were collected from the course coordinator and entered into SPSS.
10. Results of the Study

Results are considered in relation to each of the limited hypotheses.

**Hypothesis one:** *Students who use the Web-assisted learning package will exhibit enhanced scores on the examination measures compared to students who do not use the package.*

Seventy-one students logged onto the Web-assisted learning package prior to sitting for the examination, and 138 students did not use this facility. These groups as mentioned previously are called package participants (PP) and non-package students (NPS). The examination scores consisted of two parts, (a) Part A, science, reading and writing section, scored out of 20%, and (b) Part B, the general section, scored out of 80%. The two groups, PP and NPS, did not differ significantly on Part B (means of 55.9 and 54.5, $F(1, 205) = 1.49, \text{ns}$). However, on Part A, the PP students performed better than the NPS students, means of 13.2 and 11.7, $F(1, 206) = 14.5$, $p = .001$. The effect is shown in Figure 3 in which both Part A and Part B scores have been converted to represent scores out of 100% in each case. This effect was significant even after controlling for prior knowledge as indexed by examination scores from the previous year’s course, entered as a covariate, $F(1, 177) = 13.046$, $p < 0.001$. The effect size was calculated, using Cohen’s $d$, at 0.55. (Note, Cohen’s $d$ expresses means differences in terms of standard deviation units). A repeated measures ANOVA using the participants status (PP & NPS) as independent variable with repeated measures across the two exam scores, showed a significant interaction effect, $F(1, 205) = 10.4$, $p = .001$.

Thus, the data indicate clearly that hypothesis one, that online participation would facilitate examination performance, was supported. Further, this significant effect apparently was not explained by the possibility that “better” students would avail themselves of the online facility, since the scores of the two groups did not differ on the sections of the examination that were unrelated to the content of the online facility. Further, the PP students and NPS groups did not differ on their examination scores for the previous year’s course.
Hypothesis two: *Students who used the Web-assisted learning package will show positive attitudes towards using the Web in learning.*

Table 3 presents the means and standard deviations for individual statements for student attitudes towards Web-assisted learning. Student attitudes towards Web-assisted learning were generally positive. The possible range was from 6 to 30, with 18 as the natural middle point, representing neutrality. However, the actual mean attitude score was 21.50 with a standard deviation of 3.8. The actual attitudes scores in the study ranged from 14 to 30, with 78% of the respondents exhibiting positive attitude (i.e., score higher than the midpoint of 18).
Discussion

In this section the findings of the current study are discussed in relation to the research questions and in light of the relevant research literature.

One of the main questions raised in the present study was whether Web-assisted learning as an adjunct to traditional learning will assist students in their learning within a university course. The results of the study showed that students who used the package and the traditional lectures outperformed significantly those who used only the traditional lectures. This effect was significant even after controlling for the prior knowledge factor as indicated by scores from the previous course (i.e. Educational Psychology 1). Further, the significant effect apparently was not explained by the possibility that “better” students would avail themselves of the online facility, since the scores of the two groups did not differ on the sections of the examination that were unrelated to the content of the online facility. The present finding is consistent with a study by Lin, Tseng and Chiang (2017) where the results showed that the blended learning experience benefitted students in the experimental group by having a positive effect not only on the learning outcomes, but also on their attitudes toward studying mathematics in a blended environment. Furthermore, Redding and Rotzien (2001) found in their study that online instruction was a valuable supplementary resource for classroom instruction. It appears that students benefit from a mixed model, where the traditional lecture is supplemented with online learning.

There are a few factors that could have contributed to the greater improvement for the package plus lecture group. The time on task element could have had an effect on the outcome.

Table 3

<table>
<thead>
<tr>
<th>Attitude Statements</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning through Web-assisted learning is convenient</td>
<td>4.19</td>
<td>0.627</td>
</tr>
<tr>
<td>Web-assisted learning allow me to control the pace of my learning</td>
<td>4.13</td>
<td>0.525</td>
</tr>
<tr>
<td>Web-assisted learning provide me with learning opportunities that otherwise would not have had</td>
<td>3.35</td>
<td>0.861</td>
</tr>
<tr>
<td>I enjoy learning from the Web-assisted lessons</td>
<td>3.33</td>
<td>0.935</td>
</tr>
<tr>
<td>Web-assisted learning should be utilized more often to deliver instruction</td>
<td>3.27</td>
<td>0.931</td>
</tr>
<tr>
<td>I will recommend Web-assisted learning to my friends</td>
<td>3.19</td>
<td>0.908</td>
</tr>
<tr>
<td>Total</td>
<td>21.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Note: (a) The means are out of 5. (b) Scale 1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree.
Students who used the package possibly spent more time studying Part A (i.e., science, reading and writing) than the other students. As process measures were not taken, there is no possibility of testing for this idea.

Another possible explanation is that students may have found the material on the Website well organised, and relatively easy to follow, and therefore, genuinely facilitative of their learning. Of especial value were the concept maps when used as an instructional strategy. Evidence for this idea stems from comments students registered on the Website itself. Students were able to register these comments immediately after working upon the package material. One of the comments was that “this site has been an excellent help in the study process, and it would be excellent if all the lectures were available in this format as it helps to put the information into a clear context”. Another student commented that “the concept map idea was helpful, because I could see how information was related”.

These findings are consistent with the notion that concept maps are especially valuable in helping novice learners understand complex concepts and encourage a deep level of information processing. Research studies supports such notion (e.g., Dunston, 1992; Moore & Readance, 1984). For example, in an analysis of science student views on concept mapping reported by Santhanam, Leach, and Dawson (1998), up to approximately 33% agreed that the technique ‘encouraged thinking more deeply’ while up to approximately 50% agreed that it ‘helped in understanding relationships between concepts’. In another meta-analysis conducted by Nesbit and Adesope (2006), the use of concept maps was associated with increased knowledge retention across several instructional conditions and settings.

In general, students in the present study showed high positive attitudes towards Web-assisted learning. The majority of the students found that Web-assisted learning was a convenient environment for learning as it allowed them to control the pace of their learning and gave them more opportunities for learning. This finding echoed Jung, Choi, Lim, and Leem’s (2002) results. They found in their study that taking a Web-based course can cause learners to view online learning more positively regardless the type of interaction the learners experienced online. Moreover, studies by Ercan and Bilen (2014), Luckevich (2008), and Hancer and Yalcin (2007) examining students’ attitudes towards Web-assisted learning found that most students showed positive attitudes towards Web-based instruction and were comfortable working in a Web-based environment.

Perhaps providing learning opportunities outside the classrooms and facilitating communication through providing all-time access to learning made Web-assisted learning receive positive attitudes from its users. Further, it was found that prior online learning experience and computer skills were found to correlate positively with learning outcomes and attitude toward online learning (Oh & Lim, 2005). However, a curious finding in the present data was that positive attitudes were evident in students who did not necessarily score highly
on the examination. In fact achievement and attitude were correlated negatively, a statistical finding that must be interpreted in the light that overall attitudes were highly positive, but more positive in this case of students within the lower and middle attainment ranges. It ought to be acknowledged that relationships between attitudes and learning are never simple or direct.

12. Recommendations for Further Investigations

The present study was not a controlled study as such. It was a field study which attempted to capitalise on a treatment option as offered to students participating in an ongoing course. Therefore, it is suggested to run a quasi-experimental study. It is also recommended to further investigate the role of concept maps and other instructional strategies in enhancing learning in Web-based learning environments and look for possible interaction effect between instructional strategies and individual differences such as cognitive style, prior knowledge.

Reference


Stocks, J. T., & Freddolino, P. P., 2000, 'Enhancing computer-mediated teaching through interactivity: The second iteration of a world wide Web-based graduate social work course’, Research on Social Work Practice, 10(4), 505-518.


