Effects of Learning Styles on Undergraduates’ Attitudes, Navigational Patterns, and Use of Navigational Tools in Hypermedia-Based Learning

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Abstract

This study aimed to identify undergraduates’ learning style, their attitudes towards hypermedia-based learning (HBL), their navigational pattern and the navigational tools used during HBL sessions, and the differences in the above processes based on their learning styles. A questionnaire was used to collect data on their attitudes towards HBL. Kolb learning style inventory was used to determine the learning styles of the undergraduates. Observations and self-reports were used to determine navigational pattern and navigational tools utilized in HBL. Subjects consisted of 15 undergraduates taking a social psychology course in the Cognitive Science Program at Universiti Malaysia Sarawak. Subjects were required to navigate HBL social psychology web site http://www.trinity.edu/~mkearl/socpsy.html. Findings indicated that all the subjects have positive attitudes towards HBL regardless of their learning styles. Diverger and assimilator learning styles subjects was “prudent” navigator, while converger and accommodator learning style subjects were “daring” navigator. Two main navigational tools used were the hyperlinks and back buttons and this pattern were the same regardless of the subjects learning style.

Introduction

Hypermedia, sometimes called interactive multimedia (Jeffcoate, 1995), combines both the features of hypertext and multimedia. Hypermedia allows learners nonlinear access to information through links provided within text, graphics, animation, audio and video. Hypermedia is believed to hold great promises and potentials for learning and instruction. Hypermedia environment is considered to be a flexible instructional environment in which varied instructional needs can be addressed.

Hypermedia-Based Learning (HBL) embraces advantages that makes it appear to be an ideal learning environment (Henry, 1995). Learners can control the pace, sequence, and content of HBL. Learners can traverse the instructional information at their own speed, choose to review, continue, or terminate an instructional session. Various learning preferences can be accommodate through the use of multiple media such as text, graphics, animation, audio and video, which also act as powerful motivational tools. Barab, Bowdish and Lawless (1994) posit that hypermedia allows for learners with unique intentions and purposes to determine which and in what order, information will be displayed; potentially configuring what, when and how learning will transpire. As a result, learners can tailor the educational experience to meet their own unique needs, interests and goals.
Universiti Malaysia Sarawak (http://www.unimas.my), put heavy emphasizes on the use of information technology to enhance the learning experience (Universiti Malaysia Sarawak Annual Report, 1996). Part of these efforts centered on using the World Wide Web (WWW) and other HBL environments both developed by the lecturers or source from other educational sites.

Nonetheless the attitudes of learners towards a particular medium for providing the learning experiences will influence the success or failure of that medium. A positive attitude will enhance the chances of the learners to use and hopefully benefit from their interaction with the medium. Likewise there is a need to understand the navigational patterns and use of the navigational tools provided to better design HBL environment for undergraduates of University Malaysia Sarawak in the future.

However, it should be noted that individuals have different learning styles, characteristics, strengths and preferences in the way individuals take in and process information. Some respond to visual forms of information (picture, diagrams and schematics), others gained more from verbal forms (written and spoken). Some prefer too learn actively and interactively, others function better introspectively and individually. Does these differences in learning styles among UNIMAS undergraduates will influence their navigation patterns and use of navigational tools in HBL?

**Research Questions**

This is an exploratory study aimed to discover UNIMAS undergraduates’ reaction towards HBL and how they function within the HBL environment. Specifically, this study attempted to

1. determine the undergraduates’ learning styles,
2. explore the undergraduates’ attitudes towards HBL,
3. determined the navigational patterns within the HBL environment, and
4. ascertained the navigational tools utilized during interaction with the HBL, and
5. determine differences in navigation patterns and use of navigational tools for the different learning styles

**Definition of Terms**

**Hypermedia:** Hypermedia is a fusion of Hypertext and Multimedia. It defines a non-linear way of accessing information and the information can be represented in many formats.

**Hypermedia Based Learning (HBL):** HBL is a learning environment that is based on the hypermedia concept of presenting information. In this study, HBL refers to course material for Introduction to Social Psychology available on the World Wide Web (http://www.trinity.edu/~mkearl/socpsy.html). The content of this course is hyperlink in the form of plain text, pictures and graphics. Learners can traverse from unit to unit within the course by selecting appropriate links.

**Navigational Pattern:** Navigation pattern refers to the style or approach users’ take in accessing the HBL environment. “Prudent” users will have navigational pattern that show exploration centering around the neighborhood of the main node before slowly moving further away from the node. “Daring” users will access links further and further away from
the main node and will only return to the main node when they reach a without any outgoing links.

**Attitudes toward HBL:** Attitudes towards HBL refer to the undergraduates’ emotional, informational and behavioral responses towards their experience in using HBL environment. The emotional component includes feelings about HBL, positive, neutral or negative. The informational component consists of the beliefs and information the subjects have about HBL. Finally, the behavioral component consists of the subjects’ tendencies to behave in a particular way towards HBL. These definitions are proposed by Luthans (1989).

**Learning Styles:** Learning style is a biologically and developmentally imposed set of personal characteristics that make the same teaching and learning strategy effective for some and ineffective for others (Brickell, 1993). This study utilized the Kolb’s learning style (Kolb, Osland, & Rubin, 1995). The Kolb’s learning style has a learning process, which can be conceived of as a four-stage cycles. Observation and reflection follow concrete experience, which lead to the formation of abstract concepts and generations. This further lead to hypotheses to be tested in future action, which in turn lead to new experiences. Kolb states that most people apply these four processes in a cyclical fashion as they learn, but that each person engages in some activities more than others do. There are four learning styles, which comprised of a combination of these preferences.

![Kolb's four-stage cycle](image)

**Figure 1.** Kolb’s four-stage cycle. Adapted from Scriven, 1996

Divergent learning style emphasizes concrete experience and reflective observation. Divergers perform better in situations that call for generation of ideas and implications such as “brainstorming” idea session. Divergers learn best by reflecting on experiences and drawing new ideas. Such learners tend to be imaginative and like to generate creative ideas.

For assimilation learning style, the dominant learning abilities are abstract conceptualization and reflective observation. They like to integrate ideas and are more interested in theoretical concerns than in applications. The person examines his or her experiences from different perspectives, then forms abstract concepts or generalizations.

The convergent learner relies primarily on the dominant learning abilities of abstract conceptualization and active experimentation. The greatest strength of convergers is problem
solving, decision making, and the practical application of ideas. They prefer dealing with technical tasks and problems rather than with social and interpersonal issues.

The greatest strength of the accommodative learning style lies in doing things, in carrying out plans and tasks, and in getting involved in new experiences. People with an accommodative orientation tend to solve problems in an intuitive trial and error manner, relying on other people for information rather than on their own analytic ability.

**Related Literature Review**

Hypermedia systems possess a number of characteristics that advocates have claimed are beneficial to the learning process (Chen & Ford). Among others, hypermedia:

- provides a highly interactive environment,
- allows the integration of different media, such as text, video, audio and graphics, and
- has a non-linear organization in the form of a network of nodes and links

There are two types of hypermedia system, traditional “stand-alone” form of hypermedia on CD-ROMs and networked hypermedia system on the World Wide Web. This study focussed on the later hypermedia system. According to McCool (1997), the World Wide Web is a distributed, open hypermedia system, which is currently the primary way to deliver integrated multimedia services over the Internet.

HBL provides a nonlinear method of establishing relationships that are more meaningful to the individual learner because of the context-based linkages that are used. Traditional forms of computer instruction have more often relied upon linear relationships between and among concepts, which have constrained learners by restricting them to develop fewer less meaningful relationships among concepts. The integrated use of sound, video, graphics and text purportedly establishes the HBL environment as an extremely rich method of instruction, in which the learner is capable of formulating more numerous and more meaningful relationships. This multi-modal approach is thought to benefit learners who have been neglected by more traditional forms of instruction (Ayermans & von Minden, 1995)

Navigation is the primary means to access information in a hypermedia system. The ability to navigate makes hypermedia a powerful tool for managing information. According to Bra, different users follow different strategy of navigation, which is either “prudent” or “daring”. Prudent users explore the neighborhood of the node they start from before moving further away. This strategy is also termed “breadth-first” navigation. The “daring” dive into the hyper-document, moving further and further away by following links (forwards) and only backing out when they reached a node without no outgoing links. This strategy is also called “depth-first” navigation.

In an effort to increase the effectiveness of the hypermedia systems, the focus of research has shifted from the systems to users (Chen & Ford). Among others, users’ characteristics, in particular their learning style effects on effectiveness of hypermedia systems should be better understood.

Researchers tend to study the effects of learning styles on achievement from learning with HBL. Barbe and Milone (1980) and Ayersman (1994) using different construct measures of learning styles report that there were no significant differences between the different learning styles.
style groups on achievement from HBL. It appears that hypermedia can encompass a diversity of students’ style preferences by incorporating user options and multi-modal instructional features for learning. However, there was lack of researches available on effects of learning styles on navigational pattern or use of navigational tools within a HBL environment.

**Methodology**

This research employ the survey method to obtain self-answer to paper-and-pencil questionnaire and inventory after subjects have gone through a HBL supplemental material.

**Research Instrument**

The research instrument consisted of a questionnaire and a learning style inventory. The questionnaire elicit the following information from the subjects:

- attitudes toward HBL
- navigational pattern
- navigational tools utilized

**Attitudes toward HBL**

This section of the questionnaire that measures attitudes towards HBL consists of 19 statements, each with five Likert Scales choices: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree. Sample statements are shown below:

1. I feel comfortable with the HBL session  
2. I am not phobic to HBL  
3. I find HBL easy to navigate

Statements 1 to 7 refer to the emotional component, statements 8 to 16 the informational component and statements 17 to 9 the behavioral component of the attitude scale as proposed by Luthans (1989). The 19 statements are shown in Table 2.

The Cronbach Alpha reliability index of the measures of attitudes towards HBL was 0.8358 on a pilot study involving 25 subjects selected randomly from second year students taking Human Development Program at the Faculty of Cognitive Sciences and Human Development, UNIMAS.

**Navigational Tools and Navigational Patterns**

Use of navigational tools were self-recorded by the subjects using a sample table as shown below:

<table>
<thead>
<tr>
<th>Tools Used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Button</td>
<td></td>
</tr>
<tr>
<td>Forward Button</td>
<td></td>
</tr>
<tr>
<td>Refresh</td>
<td></td>
</tr>
<tr>
<td>Home Button</td>
<td></td>
</tr>
</tbody>
</table>
The researchers observed at least three sessions for each of the subject, as he or she uses the HBL environment to come to a mutual agreement on each of the subject navigational pattern as either “prudent” or “daring”.

**Kolb Learning Style Inventory**

The learning style inventory used to determine subjects learning preferences was the Kolb Learning Style Inventory (Kolb et al., 1995). There are nine sets of four descriptions in this inventory. Subjects have to mark the words in each set that are most like them as 1, second most like them as 2, third most like them as 3, and least like them as 4.

<table>
<thead>
<tr>
<th></th>
<th>Discriminating</th>
<th>Tentative</th>
<th>Involved</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Receptive</td>
<td>Relevant</td>
<td>Analytical</td>
<td>Impartial</td>
</tr>
<tr>
<td>2</td>
<td>Feeling</td>
<td>Watching</td>
<td>Thinking</td>
<td>Doing</td>
</tr>
<tr>
<td>3</td>
<td>Accepting</td>
<td>Risk taker</td>
<td>Evaluative</td>
<td>Aware</td>
</tr>
<tr>
<td>4</td>
<td>Intuitive</td>
<td>Productive</td>
<td>Logical</td>
<td>Questioning</td>
</tr>
<tr>
<td>5</td>
<td>Abstract</td>
<td>Observing</td>
<td>Concrete</td>
<td>Active</td>
</tr>
<tr>
<td>6</td>
<td>Present-oriented</td>
<td>Reflecting</td>
<td>Future-oriented</td>
<td>Pragmatic</td>
</tr>
<tr>
<td>7</td>
<td>Experience</td>
<td>Observation</td>
<td>Conceptualization</td>
<td>Experimentation</td>
</tr>
<tr>
<td>8</td>
<td>Intense</td>
<td>Reserved</td>
<td>Rational</td>
<td>responsible</td>
</tr>
</tbody>
</table>

The four columns or words corresponded to the four learning style scales: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE). To compute subjects’ scale scores, the rank number for each items in the individual column are summed. The first column refer to CE, second column to RO, third column to AC and the last column to AE.

To identify the learning style of each subject, two combination scores, AC-CE and AE-RO were used. The grid as shown in Figure 2 below was used to shows raw scores for these two scales on the crossed line. By marking the raw scores on the two lines and plotting their point intersection, we can find which of the four learning styles quadrants the subjects occupied. These four quadrants, labeled as accommodator, diverger, converger, and assimilator, represented the four dominant learning styles. The closer the data point was to the point where the lines crossed, the more balanced was the subject’s learning style. If the data point is close to any of the four corners, this indicates that the subject relied heavily on one particular leaning style (Kolb, et al., 1995).
Subjects for this study consisted of second year undergraduates undertaking Cognitive Science Program within the Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia. These students were following a course on Introduction to Social Psychology which include availing themselves to a HBL available online on the World Wide Web (http://www.trinity.edu/~mkearl/socpsy.html).

All the 31 undergraduates in the course were administere d the questionnaire and Kolb learning style inventory after completing the sessions of HBL required in December 1998. However, only 15 fully completed questionnaires were used in the final analysis. Eight of the subjects were female and seven were male. Most of the subjects (N=11, 73.3%) used the Internet more than three times a week on the average. One of the subjects (6.7%) used the Internet, on the average three times a week, two (13.3%) used on the average twice a week, and one (6.7%) used the Internet on the average once a week.

Data Analysis

The descriptive statistics, mean and standard deviation were employed to obtain answer for all the research objectives.
Results

Learning style

Based on responses to the Kolb Learning Style Inventory, six (40.0%) of the subjects have divergent learning style, four (26.7%) have assimilation style, two (13.3%) have convergent style and three (20.0%) have accommodative learning style.

Attitudes towards HBL

Referring to subjects' responses to the attitudinal section of the questionnaire (Table 2), sum of the scores for each respondent to the 19 statements was categorized as negative attitude towards HBL (19-44), neutral attitude towards HBL (45-69) and positive attitude towards HBL (70-95). All but two of the subjects have positive attitudes toward HBL environment. Only two subjects with divergent learning style have neutral attitudes towards HBL environment.

Table 1

<table>
<thead>
<tr>
<th>Learning Styles</th>
<th>Attitudes towards HBL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative (N)</td>
</tr>
<tr>
<td>Divergent</td>
<td>0</td>
</tr>
<tr>
<td>Assimilation</td>
<td>0</td>
</tr>
<tr>
<td>Convergent</td>
<td>0</td>
</tr>
<tr>
<td>Accomodative</td>
<td>0</td>
</tr>
</tbody>
</table>

Referring to Table 2, generally the subjects were comfortable with and found using the HBL environment easy. They felt that the use of HBL was appropriate, and do not need much guidance from the course instructors. Nonetheless, statement 9, indicated that the use of HBL did not encouraged them to skip lectures. Subjects also did not indicate a preference for HBL over traditional face-to-face interactions as shown by their responses to statement 10. Responses to statement 5 also indicated that the subjects did not find that learning with HBL was easier compared to lectures.

Table 2

<table>
<thead>
<tr>
<th>Statements</th>
<th>Choices</th>
<th>Mode</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel comfortable with the HBL session</td>
<td>0 0 1 6 8 5</td>
<td>4.47</td>
<td></td>
</tr>
<tr>
<td>2. I am not phobic to HBL</td>
<td>0 0 0 4 11 5</td>
<td>4.73</td>
<td></td>
</tr>
<tr>
<td>3. I find HBL easy to navigate</td>
<td>0 0 0 6 9 5</td>
<td>4.60</td>
<td></td>
</tr>
<tr>
<td>4. HBL is not too difficult for me</td>
<td>0 0 0 6 9 5</td>
<td>4.60</td>
<td></td>
</tr>
<tr>
<td>5. It is easier to learn with HBL compared</td>
<td>0 0 10 4 1 3</td>
<td>3.40</td>
<td></td>
</tr>
<tr>
<td>to lectures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I enjoy learning with HBL</td>
<td>0 0 3 10 2 4</td>
<td>3.93</td>
<td></td>
</tr>
</tbody>
</table>
7. I do not feel bored learning with HBL.  
8. I don’t feel lost in the HBL environment  
9. Having HBL environment discouraged me from attending lectures  
10. I prefer HBL compared to lectures  
11. HBL helped me better understand the course material  
12. I did not faced any difficulty learning with HBL  
13. HBL is an appropriate medium to present the course material  
14. I can access HBL material without problem  
15. I need my lecturer to facilitate this HBL  
16. The use of HBL to supplement the lectures is useful for this course  
17. I would prefer to print the course material in the HBL web-site  
18. I would like to know more about HBL  
19. I will use other HBL environments in the future

Note: 1= Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Navigational Pattern

Detail classification of the subjects learning styles and their navigational styles are shown in Table 3 below. In general, majority of the subjects with “divergent” or “assimilation” learning style showed “prudent” navigational pattern. However, both the convergent learning style subjects and two out of the three accommodative learning style subjects displayed “daring” navigational pattern.

Table 3
Navigational Pattern.

<table>
<thead>
<tr>
<th>Learning Styles</th>
<th>Navigational Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prudent</td>
</tr>
<tr>
<td>Divergent</td>
<td>5</td>
</tr>
<tr>
<td>Assimilation</td>
<td>4</td>
</tr>
<tr>
<td>Convergent</td>
<td>0</td>
</tr>
<tr>
<td>Accomodative</td>
<td>1</td>
</tr>
</tbody>
</table>

Navigational Tools Used

Table 4 summarized the navigational tools used by the subjects during the HBL. The two common navigational tools used were the Back Button and Hyperlinks regardless of the subjects learning styles. The other navigational tool of significance used by the “divergent” and “assimilation” learning styles subjects was “Save As”. Other navigational tools were not used at all or very rarely.
Table 4
Mean frequency of navigational tools used per session of HBL.

<table>
<thead>
<tr>
<th>Navigational Tools</th>
<th>Learning Styles</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Divergent</td>
<td>Assimilation</td>
<td>Convergent</td>
<td>Accomodative</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Back Button</td>
<td>9.8</td>
<td>13.8</td>
<td>7.5</td>
<td>16.3</td>
</tr>
<tr>
<td>Forward Button</td>
<td>1.5</td>
<td>1.8</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Home</td>
<td>1.0</td>
<td>0.5</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Images</td>
<td>1.7</td>
<td>0.9</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>New Window</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Refresh Button</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Save As</td>
<td>3.8</td>
<td>3.3</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Search Button</td>
<td>0.0</td>
<td>0.3</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Hyperlink</td>
<td>11.8</td>
<td>11.0</td>
<td>16.5</td>
<td>11.7</td>
</tr>
<tr>
<td>Stop Button</td>
<td>1.3</td>
<td>1.9</td>
<td>1.0</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Discussions

Although of the 15 subjects, six have “divergent” learning style and four were “assimilation” learning style; each learning style were present among the subjects. This would indicate that in any population of undergraduates within UNIMAS campus a varied of learning styles exist. Thus it is important that the teaching community within UNIMAS bear this fact in mind when designing the learning processes.

The findings indicated that the subjects have positive attitude towards hypermedia based learning. Most of them were comfortable with HBL, and found no problem navigating and using the hypermedia environment. Majority of them would like to learn more about HBL and look forward to using HBL environment in the future. However, majority of the subjects prefer to print course notes from the HBL in contrast to Hart’s (1995) finding which indicate that only “convergent” learning styles subjects tend to do so. All the subjects’ have positive attitudes toward HBL among the differing learning styles except two divergers who were neutral in their attitudes toward HBL.

Majority of the subjects in this study was “prudent” navigators. “Divergent” and “assimilation” learning styles were “prudent” navigators, while “convergent” and “accomodative” learning styles were “daring” navigators. “Prudent” navigators only navigate one link from the starting node and then they will return to the starting mode.

Two major navigational tools used by the subjects were hyperlinks and the Back button. There were no differences in the use of navigational tools among the four learning styles.

Conclusion

This study is only exploratory in nature. The limited size and nature of the subjects from only one program within a faculty delimits the generalization of the results of this study. A
followed-up study, more comprehensive and with controlled experimental design will give a clearer picture of the undergraduates’ attitudes toward HBL environment, navigational patterns, and navigational tools used and the effects of undergraduates’ learning styles on the three variables.

Bibliography


