

Using Learning Styles and Preferences to Incorporate Emerging E-learning Tools in Teaching

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Abstract

Emerging e-learning tools have the potential to enrich academic environments. However, there is a need to understand the requirements, expectations, and learning styles of the end users before incorporating new tools into courses. This paper presents details of a user study to analyze learning styles and tools preferences of the end users and to explore significant relationships among them. The study outcomes highlight several significant relationships and reveal the tools preferences of various learner types. In contrast with existing studies, our study report balanced or unbiased academic performances across all learner types.

1. Introduction

The adoption level of emerging e-learning tools is on the rise in educational settings [1]. These tools include blogs, wikis, instant messengers (IM), social bookmarks, podcasts, vodcasts, etc. Several examples can be sighted for incorporating these tools into courses [2-4]. However, there is a need to understand the requirements, expectations, and learning styles of the end users before incorporating new tools into courses. A review of learning theory literature suggests that learning styles and preferences influence the effectiveness with which individual learners learn. Therefore, a first hand knowledge of students' learning styles and preferences can help lecturers choose the right methods of instruction for the right audience [5]. Thus the aim of our research is to explore significant relationships between learning styles and preferences of using emerging e-learning tools in order to enable the wide range of students to achieve satisfactory academic performance. This would help understand the tools preferences of various learner types and

effectively incorporate them into our courses. The study involved first year ICT students of a Web programming course and comprised of two separate surveys which were aimed at collecting learning styles and preferences of using emerging e-learning tools. The study outcomes highlight several significant relationships between learning styles, tools preferences as well as academic performances. These outcomes are encouraging for lecturers who wish to incorporate emerging e-learning tools into their courses.

The rest of the paper is organized as follows. Section 2 presents an overview of the academic uses of emerging e-learning tools and learning styles. The results of learning styles and tools preference surveys are presented in Section 3. We address the significant relationships between learning styles and tools preferences in Section 4. Section 5 presents the significant relationships between learning styles and academic performances. A discussion on study results is detailed in Section 6. Section 7 concludes our study and points out the future work.

2. Related work

With the creation of emerging e-learning tools such as blogs, wikis, IM, social bookmarks, podcasts, vodcasts, etc; the Web is transforming into a fully interactive space and the control of content has been decentralized in order to allow every one to collaborate, create, publish, subscribe, and share information [6]. In academic settings, students and lecturers alike are achieving many of the benefits of these interactions [7]. For example, blogs facilitate publication of knowledge, opportunities for subsequent reflection and analysis, and help learners understand the relational and contextual basis of knowledge, knowledge construction and meaning making [8]. Similarly, wikis facilitate the creation of shared knowledge, dissemination of information, and group interaction [4]; social bookmarks allow quick and easy

access to online resources and provide an ‘insiders’ guide to information and references [6]; and podcasts provide an innovative and exciting way for people to improve communication, collaboration and social networking [9]. All these features are key learning elements and make emerging tools appropriate for educational settings. However, to help students achieve the full cognitive development, lecturers need to be amongst the early adopters of these technologies by integrating them with the end user experience and learning styles [7]. We aim to address these issues in our study by exploring significant relationships between learning styles and emerging e-learning tools.

Learning style is a distinctive and habitual manner of acquiring knowledge, skills or attitudes through study or experience while learning preference is favoring of one particular mode of teaching over another [10]. In academic settings, students learn in a variety of ways - some tend to focus on facts, data and algorithms; others feel more comfortable with theories and mathematical models. Some conceive more from visual information like pictures, diagrams and simulations; others get more from spoken and written information. Some prefer interactive learning; others learn well individually [11]. Existing studies show that matching learning styles with teaching methods is advantageous to academic achievements [5]. For example, Butler et al. compares the learning styles with online teaching preferences (using Gregorc Learning Styles Delineator) and report the dual learning style (Concrete-Random / Abstract-Sequential) as dominant with strong preferences for asynchronous interactions [12]. However, their study does not report any relationships between learning styles and emerging e-learning tools. We wish to explore such relationships in our study using Felder-Silverman’s dimensions of learning styles.

3. Two surveys

At the beginning of 2007, the students in the Web programming course were requested to participate in two separate surveys voluntarily. One survey was about students’ learning styles and the other was about e-learning tools preferences. In this section, we report the results of these two surveys.

3.1. Learning styles survey results

Felder-Soloman’s index of learning style (ILS) was used to collect students’ learning styles data. Felder’s model classifies students as: active-reflective; sensing-intuitive; visual-verbal; and sequential-global learners [11]. The Felder’s ILS consists of 44 questions each

carries two responses (a or b) and provides the scores (as 11A, 9A, 7A, 5A, 3A, 1A, 1B, 3B, 5B, 7B, 9B, 11B) for each of the four scales. Scores 1-3 on either side of the scales represent well-balanced or ‘mild’ preference, scores 5-7 represent ‘moderate’ and scores 9-11 represent ‘strong’ preference - a total of 12 possible outcomes on each learning style scale.

3.1.1. Demographics. With a total number of 204 enrolled students, over half (58.3%, N=119) responded to the learning styles survey including 101 (84.9%) males and 18 (15.1%) females. The majority (85.7%) was aged between 21 and 29. The oldest participant was aged 40 while youngest was aged 18.

3.1.2. Gender and age distributions. The Chi square analysis of gender and four learning style scales revealed no significant differences in the proportion of males and females on any of the learning styles scale. Similar results were obtained for the distribution of learning styles into different age groups. These results contradict with some previous studies which report gender and age differences among various learning styles[5]. (Note: For significant results the Chi square values should be .05 or smaller [13])

3.1.3. Learning styles frequency distribution. Table 1 presents the mean and standard deviation values for each of the learning style scales. These figures show that the majority of students exhibit well-balanced learning style except those on the visual-verbal scale where verbal dimension is dominant. These results are consistent with the findings of Alfonseca et al. [14].

Table1: Mean and standard deviation of four learning style scales

| LS scales | Mean | Std. deviation |
|---------------------|------|----------------|
| Active - Reflective | .73 | 4.288 |
| Sensing – Intuitive | 2.45 | 4.459 |
| Visual – Verbal | 5.8 | 4.063 |
| Sequential - Global | 2.16 | 3.959 |

3.1.4. Correlations between learning styles. The Pearson correlation coefficient revealed only two significant relationships within the four learning style scales. A small positive relationship between active-reflective and visual-verbal scales ($r=.191$, $N=119$, $p<0.05$); and another small positive relationship between sensing-intuitive and sequential-global scales ($r=.216$, $N=119$, $p<0.05$). (Note: In large samples ($N=100+$), very small correlations may be statistically significant [13]). These results suggest that reflective learners are correlated with verbal learners while intuitive learners are correlated with global learners. These findings are also consistent with those reported

by Alfonseca et al. and may be used to form appropriate groups in programming assignments or projects. (Note that the strengths of relationships are measured as: $r = .10$ to $.29 \rightarrow$ small; $r = .30$ to $.49 \rightarrow$ moderate; $r = .50$ to $1.0 \rightarrow$ strong [13]).

3.2. E-learning tools preference survey results

A self-designed questionnaire was used to collect students' current experience and preferences of using emerging e-learning tools mentioned earlier, along with some other traditional e-learning tools like email and Blackboard (course management tool used university wide: <http://www.blackboard.com>). Note that social bookmarks do not correspond to any of the academic activities mentioned in Table 2, hence not included in the preference part of the questionnaire.

3.2.1. Demographics. Over half (51.4%, $N=105$) of the class responded to the tools preference survey including 90 (85.7%) males and 15 (14.3%) females. The majority (84.8%) was aged between 21 and 29. Nearly 70% reported their Internet usage as more than 15 hours per week while 82.2% described 'study' as their major use of the Internet. These results suggest that our students are well aware of the Web usage in education and are familiar with the Web-based e-learning tools to some extent.

3.2.2. Gender and age distribution. The Chi square analysis of gender and tools preference variables revealed no significant differences in the proportion of males and females preferring any particular tool. However, the Chi square analysis of age and blog's preference variables revealed that the younger (18-24 years) students preferred blogs more than the mature-age (25-40 years) students in the class ($\text{Sig}=.017$, $N=105$). This outcome highlights the digital literacy of the younger students in the class.

3.2.3. Tools preferences. Students were asked to rate their learning preferences on a scale of 1 (least preferred) to 5 (most preferred). Table 2 presents their preferences against various academic activities. These results suggest that besides relying on the traditional course management (Blackboard) and communication (email) tools, our students also prefer to try emerging e-learning tools like vodcast and IM. These results also suggest that our students prefer both synchronous (IM) and asynchronous (email, Blackboard, vodcast) modes of communication, which is in contrast with Butler's study reporting the preference of asynchronous tools only [12].

Table 2: Tools preferences

| Activity | Most preferred tool |
|--|-----------------------|
| To review lectures online | Vodcast |
| To submit group projects online | Email |
| To have online class discussion with lecturers | Blackboard |
| To have online group discussion | Audio conference (IM) |
| To have online study discussion with a friend | Audio conference (IM) |
| To have online office hours | Blackboard |
| To receive assignments online | Blackboard |

3.2.4. Correlation between tools preferences. Table 3 presents three strong relationships (figures in bold), three moderate relationships (figures in italic) and two small relationships (all significant at $p<0.05$), all in the positive direction, i.e., the higher preference for one tool means the higher preference for the other. These results suggest that the learning preferences of various e-learning tools are closely related, i.e., our students prefer to try various tools in their study routines instead of relying on one particular tool. These results are also encouraging for lecturers who wish to incorporate a combination of e-learning tools in their courses.

Table 3: Correlation between tools preferences

| | BB | blog | email | IM | pod | vod | wiki |
|-------|------------|------------|------------|------------|------------|------------|------------|
| BB | | | .51 | | | | |
| blog | | | | <i>.38</i> | <i>.29</i> | | |
| email | .51 | | | | | | |
| IM | | <i>.38</i> | | | .56 | <i>.39</i> | <i>.38</i> |
| pod | | <i>.29</i> | | .56 | | .57 | <i>.29</i> |
| vod | | | | <i>.39</i> | .57 | | |
| wiki | | | | <i>.38</i> | <i>.29</i> | | |

4. Learning styles vs. tools preferences

A total of 89 (79 males, 10 females) students responded to both learning styles and tools preference questionnaires. Several significant relationships were obtained when preferences of emerging e-learning tools were correlated with each of the learning style scales.

The active-reflective scale did not yield any significant relationship when correlated with the tools preferences. Sensing-intuitive scale was significantly correlated with the preference of using email ($r=-.12$; $N=89$) and with that of blog ($r=.12$; $N=89$). This shows that the sensors prefer to use email while the intuitors prefer to use blogs. Visual-verbal scale was significantly correlated with the preference of using

vodcast ($r=-.16$; $N=89$) while sequential-global scale was significantly correlated with the preference of using podcast ($r=-.14$; $N=89$). These results suggest that the visuals prefer vodcasts and the sequential learners prefer podcasts. We will discuss more on these results in Section 6. (Note: All above relationships were significant at $p<0.05$).

Based on the two survey outcomes, several emerging e-learning tools were selected and experimented in the Web programming course to accommodate various learner types [15].

5. Analysis on academic performance

At the end of the semester after all assessments were completed for the Web programming course, we conducted some further analysis. The Chi square analysis of academic performance and gender variables revealed no significant differences in the overall performance of males and females. Similarly, no differences were found in the overall performance of young and mature-age students in the class.

The Chi square analysis of four learning style scales and high achievers (who scored 85% or more) across various assessment components also revealed no significant differences. For example, the proportion of active learners who scored 85% or more in the overall assessment was not significantly different to that of reflective learners. Similar results were obtained for the low or average performers in the class. These results suggest that our current teaching approach is not biased towards any particular learning style(s), i.e., it accommodates all learner types to achieve our objective. The results are in contrast with some previous studies which were highly biased toward particular learning styles. For example, Chamillard and Karolick report that the reflective and verbal learners performed better than others [16]. Similar findings are reported by [17] and [18].

6. Discussion

The learning styles survey helped in analyzing the dominant learning styles, frequency distribution, and correlations among various learning styles. Although the verbal style emerged as the most frequent single learning style, the majority appeared to be 'well-balanced', which is consistent with the findings of Alfonseca et al. [14]. Butler et al. also report 'verbal' as the most frequent single learning style and 'dual' (combination of two) learning style as the dominant, in their study of comparing learning styles with the preference of online teaching methods [12]. Our findings also support Butler's idea that today's learners

are more flexible in stretching their learning style to accommodate a variety of teaching methods. The correlations within four learning style scales revealed significant relationships between reflective and verbal learners and intuitive and global learners, which is consistent with the findings of Alfonseca et al. We plan to incorporate these results in our future offerings to form appropriate groups in programming assignments or projects.

The correlations between preferences of various e-learning tools revealed that our students preferred to use both synchronous as well as asynchronous communication tools in their academic activities. This is in contrast with Butler's findings which report the preference of asynchronous tools only [12]. These results suggest that today's students are ready to experience new technologies in their study routines and are willing to collaborate using various communication modes. This claim is also supported by the fact that our younger students preferred to use blogs more than the mature-age students in the class.

The comparison of learning styles and tools preferences also resulted in some interesting relationships. Sensing learners preferred email more than the intuitive learners. Felder suggests that sensors feel more comfortable with details and happen to be more careful [19], therefore they preferred to rely on traditional communication tools (like email) in their study matters than experimenting relatively new tools like IM or blog. Intuitors, on the other hand, prefer discovering possibilities and relationships and are always ready to try out new things, therefore preferred blogs. The relationship between the visuals and vodcast was a natural phenomenon since the visuals like to learn from pictures, diagrams, flow charts, and demonstrations [19]. Sequential learners tend to gain understanding in linear steps and follow logical stepwise paths, hence podcast was a good choice for them to run the sequence of lectures at their own pace over and over again to get a better understanding of the course contents. We believe that above outcomes can serve as a guideline for the lecturers in choosing the right technology for the right audience in their courses. We wish to explore more on the relationships between learning styles and tools preferences in our follow up studies.

Another significant finding of the study emerged as the well-balanced academic performances across all learner types. No significant differences were found on the proportion of high or low performers across various learner types, age-groups, and genders. These results are in contrast with some previous studies, where academic performance was heavily biased towards particular learning styles. However, at this stage, we

can not rule out other contributing factors behind these well-balanced performances such as students' background of Web programming, motivation for the course, assessments, sample size, etc. We wish to further explore these issues in our follow up studies.

7. Conclusion and future work

This paper presents our study on analyzing students' learning styles and their preferences of using emerging e-learning tools in a Web programming course. We have been successful in establishing several significant relationships and highlighting the tools preferences of various learner types. The study outcomes clearly suggest that today's students are flexible in stretching their learning styles to accommodate varying teaching methods including the use of emerging technologies. They further suggest that the learning styles of today's learners facilitate them to experience emerging and varying technologies while their learning preferences are not limited to a particular tool. Our study conforms to the previous studies in terms of the learning styles frequency distribution and the correlations between learning styles but differs significantly on the gender and age differences in learning styles. It also differs on achieving balanced academic performances across various learner types. This study is unique in highlighting relationships between learning styles and preferences of e-learning tools. These outcomes are encouraging for lecturers who wish to incorporate emerging tools in their courses since the audience is receptive and flexible enough to take on new challenges.

This study is part of our ongoing research on incorporating emerging e-learning tools in educational settings. To further strengthen our study results, we plan to conduct follow up studies in the next level Web development courses.

8. References

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