Learning styles and student perceptions of the use of interactive online tutorials

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Abstract
This study examined the effects of learning styles on learner perceptions of the use of interactive online tutorials. Learners were categorised into five learning style categories and four learning modalities. The responses to a questionnaire with four survey dimensions were analysed in order to ascertain differences based on learning styles, gender and class standing. Researchers investigated whether relationships, interactions, main effects and associations between the variables and survey dimensions existed. The majority of learners perceived the tutorials as useful, accessible, well designed and helpful in completing assignments. Researchers found significant main effects for both gender and learning style, and gender and the perception of usefulness. The relationship between learning styles and gender was statistically significant.

Introduction
The integration of online supplements in classroom-based courses has become popular. Constructivists believe learners actively construct their own interpretation of messages, thereby leaving learners in control (Berge, 1998; Rovai, Ponton & Baker, 2008). Jonassen, Peck and Wilson (1999) point out that constructivist learning environments can include technology-based environments in which participants may engage in meaningful and useful activities. In constructivist learning environments, learning is participant-centred and participant-directed.

Several multimedia tools can be used to create interactive instructional material that includes more than static text and graphics (Birch & Sankey, 2008; Deal, 2002). The use of interactive multimedia can make learning more pleasant and offers learners a...
chance to explore and construct their own knowledge actively (Moreno & Mayer, 2007). Online interactive multimedia resources can provide students with rich, interactive learning environments that appeal to different learning styles (Birch & Sankey, 2008).

**Literature review**
A number of multimedia software applications can be used to incorporate visual, verbal and kinaesthetic learning into online instruction. The integration of video-based simulations allows learners to control the sequence and pace of the instructional material in a way that benefits them. Some individuals may learn better when they can control the pace of presentations (Mayer, 2006). Although many multimedia software applications have been utilised in developing interactive multimedia tutorials as online supplements, each type of multimedia application offers a unique benefit to users. Different forms of media can influence learning based on the capability of the media and the methods they employ (Kozma, 1994). The proper interface of tutorials can assist in gaining students’ attention (Mayer, 2003). A good design of interactive tutorials is a vital factor in enhancing students’ learning experiences.

According to Mitchell, Chen and Macredie (2005), the use of online tutorials seem to have a positive effect on learning and the overall improvement on the students’ level of understanding of materials. The authors report a significant relationship between the usefulness, level of understanding and non-linear navigation. However, student performance was lower when the interface design of the tutorials did not match their preferences.

**Learning styles**
The term learning styles refers to individuals’ characteristics and preferred ways of gathering, organising and thinking about information (Fleming, 2005). Visual learners prefer maps, charts, graphs, diagrams and pictures. Aural learners like to explain new ideas to others and discuss topics with other students and teachers. Learners with a read/write preference favour essays, reports, textbooks and manuals. Kinaesthetic learners prefer field trips, trial and error, and hands-on approaches.

Some students enjoy a combination of visual, auditory, reading/writing and kinaesthetic activities. Lujan and DiCarlo (2006) point out that most students have multimodal learning styles. Kraetzig and Arbuthnott (2006) found that each individual uses a combination of different learning modalities to learn effectively. Each learner has a specific learning style or a set of preferences; therefore, lessons should be designed to best accommodate all learners (Zapalska & Dabb, 2002). Gender may be one of many factors that shape learners’ perceptions of the usefulness of multimedia instruction. Wehrwein, Lujan and DiCarlo (2007) found that males and females have different learning style preferences.

Researchers have defined and studied learning styles from a variety of perspectives. Some definitions may predict an individual’s preferred style, but others aim to predict
an individual’s consistent response across learning acts (Curry, 1990). There is no unified theory or concept to learning style research. Knowles, Holton and Swanson (1998) mention that all learning style inventories have suffered from limited research, questionable psychometric qualities of the instruments and inconclusive findings. Several learning style instruments or inventories can be used to assess individuals’ learning styles. They vary in length, format and complexity, and no single instrument can capture all of the richness of the phenomenon of learning styles (Hawk & Shah, 2007).

The VARK inventory developed by Fleming (2005) in 1987 provides metrics for each of four perceptual modes: visual (V), aural (A), read/write (R), and kinaesthetic (K). The instrument contains a total of 16 questions with multiple-choice responses, and participants can choose more than one answer for each question. Although learners are not restricted to only one of four modes, they may show a strong preference for one particular mode. An individual’s preference may range from a single mode to all four modes (Fleming, 2005; Hawk & Shah, 2007).

The implementation of interactive online tutorials can provide an alternative method of delivering instruction and can accommodate different learning styles. Learning benefits vary with the functions of multimedia and the students’ characteristics and preferences. The benefits can be determined by learners’ perceptions of the usefulness of the instruction in relation to their learning experiences and performances. Students’ perceptions of interactive tutorials may vary depending on their learning style preferences as well as the quality of the tutorials.

The purpose of this study is to explore the relationships between individuals’ learning styles and individuals’ perceptions pertaining to the use of interactive online tutorials in three sections of a residential undergraduate level course. The research questions were:

1. What are participants’ perceptions of the usefulness, access, interface and learner performance of the interactive online tutorials?
2. Are there any differences in participants’ responses to survey questions depending on learning styles of students?
3. Do learning styles, gender and class standing have any effects on the survey dimensions?
4. What do users like about the tutorials and what suggestions for improvements do they have?

Methodology

Procedure
Students in an undergraduate residential course were required to complete a WebQuest assignment with the use of Microsoft® Expression® Web and Microsoft Office® Picture Manager. Instructors used several class sessions to discuss Web design issues, demonstrate the software programs and provide students with time to work on the project during class time in a computer lab. Students had access to seven interactive tutorials.
(five demonstrations and two simulations) in a course management system throughout the semester in order to review the lessons. Three instructors reviewed the online tutorials prior to introducing them in class. The tutorials were embedded Flash files (.swf) that had been developed with Microsoft Captivate and composed of screen captures without audio. The demonstrations could be rewound, fast forwarded and paused. The simulations prompted students to click on certain menu items and icons, and enter text in predetermined areas. After the WebQuest assignment was submitted for grading, learners were asked to complete a paper-based questionnaire.

Data collection
Data were collected from students enrolled in three sections of a required pre-service teacher course taught by different instructors at a public research university in the Western US. Fifty-four students were enrolled in spring and summer 2008. The participants completed the online VARK learning style inventory (Fleming, 2005) and the student perception questionnaire developed by the researchers.

Fleming (2005) indicated that there is support for the use of the VARK inventory based on his research, but the instrument has not been statistically validated. The author reported that 58% of individuals believe the VARK profiles match their perception, 38% do not know and 4% indicate that the profile does not match (Fleming, 2009). Several researchers have utilised the instrument (Fearing & Riley, 2005; Hawk & Shah, 2007; Slater, Lujan & DiCarlo, 2007; Wehrwein et al, 2007; Zapalska & Dabb, 2002). Hawk and Shah indicated that the instrument’s reliability and validity are moderate. Zapalska and Dabb recommended the adoption of the instrument.

The student perception questionnaire was composed of 24 Likert-scale items, two yes or no questions, two open-ended questions and three demographic questions. The rating scale of the survey ranged from strongly disagree, 1, to strongly agree, 5. The questions were developed based on existing literature regarding students’ perceptions of the use of multimedia instruction (Ho, 2007; Mitchell et al, 2005). The survey was composed of four dimensions: (1) usefulness; (2) access; (3) interface; and (4) learner performance. The questionnaire was reviewed by a psychometric expert prior to its administration to the participants. In order to determine the reliability of the instrument, the internal reliability coefficient was calculated ($\alpha = 0.81$).

Data analysis
Forty-three (79.6%) learners completed both the perception questionnaire and VARK inventory. Seven negative items were recoded on the questionnaire before descriptive statistics were generated. Each student’s learning style result was recorded by capturing the highest score in a particular category: visual, aural, read/write or kinaesthetic. The students with the same score in two or more categories were categorised as multimodal. During the second round of the data analysis phase, the participants were reclassified according to Fleming’s (2005) learning modalities: unimodal, bimodal, trimodal or multimodal. The participants’ modality preferences were calculated based on the research algorithm described by Fleming (2009).
Several one-way analyses of variance (ANOVAs) and factorial analyses were conducted to investigate whether class standing, gender or learning styles had significant interaction with, and effects on, the four survey dimensions. Chi-square tests of association were performed to determine if the relationships between learning styles and gender, and responses to questions existed. Open coding was used for responses to open-ended questions in order to find emerging themes (Bogdan & Biklen, 1998; Strauss & Corbin, 1998).

Results

Demographics and learning styles

The respondents’ ages ranged from 18 to 53 and the majority was female (71.7%). All levels of class standing (freshman, sophomore, junior, senior and graduate students) were represented; however, the level with the highest number presented was sophomores (34.8%). The computer skills of the participants also varied. First, the participants were classified into the following learning styles: auditory (25.6%), read/write (20.9%), kinaesthetic (20.9%), visual (14.0%) and multimodal (18.6%). Then, the participants were reclassified into four learning style modalities: unimodal (39.5%), bimodal (30.3%), trimodal (0%) and multimodal (30.3%).

Research question 1

Several items on the questionnaire had a mean (M) score of 4.0 or higher. Table 1 displays the M scores and standard deviations of students’ perceptions of the usefulness of the tutorials. The majority of the respondents agreed or strongly agreed with item 3 (89.1%) and item 1 (87.0%).

None of the items on the performance scale (Table 2) had an M score at, or above, 4.00. Seventy-six per cent of the participants agreed or strongly agreed with item 10, and the majority (67.4%) agreed or strongly agreed with item 9. Approximately 56.5% of the respondents agreed or strongly agreed with item 7. Thus, the respondents’ perceptions varied relatively for questions on this scale. Several items on the accessibility scale yielded M scores above 4.0 (Table 3). Many of the respondents agreed or strongly agreed with items 17 (95.6%), 15 (93.5%), 13 (91.3%) and 16 (91.3%).

<table>
<thead>
<tr>
<th>Items</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The tutorials were useful in learning the software programs.</td>
<td>4.02</td>
<td>0.62</td>
</tr>
<tr>
<td>2. I enjoyed using the tutorial to review the material that I learned in class.</td>
<td>3.48</td>
<td>0.89</td>
</tr>
<tr>
<td>3. The tutorials aided me in understanding the material.</td>
<td>4.09</td>
<td>0.63</td>
</tr>
<tr>
<td>4. The tutorials were unnecessary in order for me to understand the material (recode).</td>
<td>3.43</td>
<td>0.96</td>
</tr>
<tr>
<td>5. The use of the tutorials made the lessons more interesting.</td>
<td>3.37</td>
<td>0.80</td>
</tr>
<tr>
<td>6. I would use other tutorials in the future.</td>
<td>3.83</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Table 1: Means (M) and standard deviations (SD) of student perception of usefulness
The majority of the participants (89.1%) disagreed or strongly disagreed with item 19, a negative item. The second highest $M$ score ($M = 3.93$) of the interface scale was scored on item 24 (Table 4); most of the respondents (80.4%) agreed or strongly agreed with this item.

Table 5 lists descriptive statistics for all four survey dimensions. The overall $M$ score of students’ perceptions of the accessibility scale ($M = 4.15$) was the highest, and the interface scale received relatively high ratings. Students’ perceptions of usefulness and performance varied more widely.
Research question 2
In order to evaluate whether or not the participants’ responses differed on survey questions depending on their learning styles, Chi-square tests were conducted. The results of the test were statistically significant for only one of the questions, item 7, \( \chi^2(6, n=43) = 14.96, p = 0.02, \eta^2 = 0.03 \).

Research question 3
A series of ANOVAs were conducted to evaluate the effects of learning styles and gender on student perceptions of the four survey dimensions. The results of a 5 \( \times \) 2 (learning styles \( \times \) gender) factorial ANOVA showed no significant interaction effects between the five VARK learning styles and gender on the perception of usefulness but a slight significant main effect for gender, \( F(9, 33) = 4.22, p = 0.048, \eta^2 = 0.11 \).

Results of a 3 \( \times \) 2 factorial ANOVA (learning modalities \( \times \) gender) indicate a significant interaction between the learning modalities and gender on the perception of performance, \( F(1, 38) = 5.35, p = 0.03, \) partial \( \eta^2 = 0.12 \), and a significant main effect for gender, \( F(1, 38) = 4.45, p = 0.04, \eta^2 = 0.11 \). Significant main effects for both learning style, \( F(2, 38) = 3.35, p = 0.046, \) partial \( \eta^2 = 0.15 \), and gender, \( F(1, 38) = 9.08, p > 0.01, \eta^2 = 0.20 \), exists on learners’ perceptions on usefulness (Table 6).

Additionally, a Chi-square test of association between learning styles and gender was performed. The relationship between learning styles and gender was statistically significant at the 0.05 alpha level, \( \chi^2(2, n=43) = 11.86, p < 0.01, \eta^2 = 0.14 \).

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Table 5: Descriptive statistics for student perceptions for all dimensions

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>M</th>
<th>Median</th>
<th>Mode</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usefulness</td>
<td>3.70</td>
<td>3.67</td>
<td>3.67</td>
<td>0.53</td>
<td>3.00</td>
</tr>
<tr>
<td>Accessibility</td>
<td>4.15</td>
<td>4.17</td>
<td>4.17</td>
<td>0.44</td>
<td>1.83</td>
</tr>
<tr>
<td>Interface</td>
<td>3.86</td>
<td>3.83</td>
<td>3.67</td>
<td>0.36</td>
<td>1.83</td>
</tr>
<tr>
<td>Performance</td>
<td>3.54</td>
<td>3.50</td>
<td>3.17</td>
<td>0.53</td>
<td>2.17</td>
</tr>
</tbody>
</table>

Note: *multiple modes exist. The smallest value is shown.

Table 6: Results of the 3 \( \times \) 2 ANOVA summary tables for the perception of usefulness

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>M</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning styles</td>
<td>2</td>
<td>0.85</td>
<td>3.35</td>
<td>0.046*</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>2.32</td>
<td>9.08</td>
<td>0.005**</td>
</tr>
<tr>
<td>Learning styles ( \times ) gender</td>
<td>1</td>
<td>0.74</td>
<td>2.90</td>
<td>0.097</td>
</tr>
<tr>
<td>Error</td>
<td>38</td>
<td>0.26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *\( p < 0.05; **p < 0.01.\)
Results of a $5 \times 5 \times 2$ factorial ANOVA (class standing $\times$ learning styles $\times$ gender) indicated no interaction among these variables and no significant main effects for any learning styles and class standing on perceptions, but there was a significant main effect for gender on both perceptions of usefulness, $F(1, 15) = 8.49$, $p = 0.01$, partial $\eta^2 = 0.36$, and perceptions of performance, $F(1, 15) = 5.36$, $p < 0.05$, partial $\eta^2 = 0.26$. The results of a $5 \times 3 \times 2$ ANOVA (class standing $\times$ learning modalities $\times$ gender) showed a significant main effect for gender on the perception of usefulness, $F(1, 23) = 8.69$, $p > 0.01$, partial $\eta^2 = 0.27$.

**Research question 4**

The first open-ended question on the survey asked the participants what they liked about the tutorials. Eleven females thought the tutorials were helpful because they were able to review the information that helped them understand the material. Seven participants commented on the self-explanatory nature of the tutorials and the actual step-by-step guide on how to complete tasks. The same number of individuals commented on the usefulness and helpfulness of the information in the tutorials. Six respondents indicated they liked the pace of the tutorials because they could follow the instruction easily. Five individuals appreciated the fact that they were able to access the online tutorials in the course management system from any computer with Internet access.

The participants were also prompted to provide suggestions for the improvement of the tutorials. Four individuals indicated the pace was too fast, whereas three of them reported the pace was too slow. Four comments pertained to the fact that the learners would like to use additional tutorials.

**Discussion**

*Learners’ perceptions*

Based on the results, most of the participants thought the tutorials were useful in learning how to use the software programs. Overall responses on the usefulness of the tutorials indicate that the tutorials were useful in learning and reviewing the material. The Pearson correlation coefficient ($r = 0.671$) suggests a positive moderate relationship between the perceptions of the usefulness of the tutorials and the perceptions of the perceived performances. As expected, the participants who thought the tutorials were useful tended to perceive an improvement in their levels of performance. The responses imply that instructors could use interactive online tutorials as a supplement to assist students in their learning.

The majority of the participants thought the tutorials helped them spend less time in learning the material and completing the assignment. Tutorials were accessed easily and most of the learners were able to navigate within them without difficulties. Although the majority thought that the tutorials were necessary in order for them to
understand the material, some of the individuals disagreed. It is encouraging that 70% of the respondents indicated that they would be willing to use other tutorials in the future.

Responses to questions depending on learning styles
Interestingly, learning styles did not impact the respondents’ answers to the survey questions to a high degree. The participants’ responses based on their learning styles differed on only one question, which referred to whether or not individuals who used the tutorials realised time savings in learning the software programs. The respondents who were categorised as unimodal responded more positively to this question.

Interactions between learning styles and gender on survey dimensions
Interactions existed between learning styles and gender on the dimension of performance. There was a relationship between the learning modalities and gender that indicates that learning styles are somewhat associated with gender. The result indicated a relationship between the participants’ learning styles and their gender with regard to their performance. The respondents perceived improvement on their performance in correlation to both their learning styles and gender. The result of a Chi-square test of association supports a strong association between the learning modalities and gender. In other words, males and females appeared to have different learning style preferences. This outcome was anticipated because gender is one of many factors that have an influence on learning styles (Slater et al., 2007). The result that more females were bimodal and multimodal than male participants was surprising because it is contradictory to the results of a study by Wehrwein et al. (2007), who found that females tend to prefer unimodal learning and males prefer multimodal learning. It was also unexpected that only males with a multimodal preference perceived a high level of improvement on their performance after reviewing the online tutorials.

Effects of learning styles, gender and class standing on survey dimension
Learning styles and gender had significant main effects on the usefulness and performance dimensions. Individuals had different perspectives regarding the usefulness of the tutorials and their perceived performance. Gender differences had an influence on both the perceptions of the usefulness and performance. The males found the tutorials more useful and helpful in improving their performance in comparison to females. These results are not surprising because males and females tend to have different preferences in learning (Slater et al., 2007; Wehrwein et al., 2007). Differences in class standing had no effect on students’ perception.

Benefits and suggestions
The students liked using the tutorials as a review and found the step-by-step guidance useful and helpful. The participants seemed to enjoy the flexibility that access to online resources gave them. The appropriate pace of the tutorials was mentioned by some; however, others had issues and reported that the tutorials were either too fast or too slow. The individuals appreciated the fact that they were able to access the online tutorials from any computer with Internet access at a time when it was convenient to
them. The learners who enjoy the online environment have mentioned flexibility and convenience as one of the major advantages of online learning (Bolliger, 2003; Simonson, Smaldino, Albright & Zvacek, 2009).

Most of the responses on the improvement of the online tutorials were positive. It is encouraging and exciting that several individuals mentioned that they would like to use additional tutorials. Changing the speed of the presentation in the tutorials was the only improvement suggested by the students. Interestingly, the users were able to control the speed in which the instructional materials were presented, and instructions had been provided on how to control the pace. Perhaps the instructor could reiterate the fact that users have navigational controls in a subsequent class session after introducing students to the tutorials.

Limitations
Limitations of the study need to be pointed out. First, the sample was a convenient sample and was only composed of education majors. Second, the geographical area was limited. Future studies could include participants in other disciplines and geographical areas. Third, the reliability of the learning styles inventory utilised has been determined to be moderate by other researchers. Several other learning style inventories with additional dimensions exist and may be administered by researchers. Fourth, the questionnaire developed by the researchers could be refined. It might be beneficial to investigate learners’ perceptions of demonstrations and simulations separately instead of combining questions pertaining to both on one questionnaire.

Conclusion
The aim of this study was to explore the relationships between individuals’ learning styles and perceptions pertaining to the use of interactive online tutorials used as supplements for a face-to-face pre-service teacher course. The study contributes to the field by providing insights into associations, interactions, relationships and main effects between learning styles, gender, class standing, and the usefulness, access and interface of interactive online tutorials and student performance. In general, the tutorials were useful and helped enhance the students’ learning. The results show that the tutorials also had an appropriate interface design and were easily accessible.

Learning styles did not have a large impact on how the students responded to the survey items. In retrospect, some of the results pertaining to the students’ learning styles are not surprising because the interactive tutorial introduced in the course incorporated text, visuals and kinaesthetic elements. The results indicate that interactive demonstrations and simulations accommodate a variety of learning styles and therefore, meet the needs of diverse learners. Evidently, gender is responsible for differences on their perceptions of the tutorials’ usefulness and learners’ performance.

Instructors may want to consider providing interactive online tutorials in their campus-based courses as supplemental materials and make their use optional. These types of tutorials may also be beneficial to online learners. Regardless of the learning
environment in which they are implemented, the design should be consistent and user-friendly. The usefulness of the tutorials may vary with the levels of the students’ technology literacy and skills.

References
Ho, W. C. (2007). Music students’ perception of the use of multimedia technology at the graduate level in Hong Kong higher education. Asia Pacific Education Review, 8, 1, 12–26.


