

Lessons on Designing Web-Based Courses for K-12 Students Based Upon Individual Learning Styles

Abstract- As e-learning begins to proliferate into secondary schools and is opened up to learners of all abilities, it is important to take into consideration the effects different learning styles have upon how online instruction is provided. In this study, students from a secondary-level business education class completed a learning styles inventory to determine their strengths based on three different measures, which was compared to the students' overall performance in the course.

Introduction

In a traditional classroom, teachers have become quite adept at modifying instruction to support the variety of learning styles that their students possess. However, within a web-based learning environment these adaptive instructional skills are still developing.

In the post-secondary environment, the various learning styles of students has had little impact on the design and deliver of distance education, largely due to the fact that these learners are much more motivated and independent in their approach to learning. However, as e-learning begins to propagate into the secondary school environment and is opened up to learners of all ability-levels, it is important that the effects that different learning styles have upon how we provide online instruction are investigated.

The Study

The Centre for Distance Learning and Innovation (CDLI) began its implementation year in 2001-02 with one course in each of the ten different school districts. The courses themselves were primarily text-based with some images. Only a select few of the courses contained any multimedia or audio components. After the pilot phase, the CDLI began to expand both its course offerings and the number of students per course. It set the student to e-teacher ratio at 80:1 and students from the province's ten school districts could access all courses.

In this study students from one two semester business education course during the 2002-03 school year completed a learning styles inventory to determine their strengths based on accelerated learning styles, David Kolb's theory of experiential learning; and Howard Gardner's theory of multiple intelligences. At the end of the school year, the students' final grades were collected and compared to their learning styles profiles and the web-based design components contained in the course.

Learning Styles

Learning styles are simply different approaches to learning. They describe the manner in which we perceive and process information the best. They can also be defined as the methods people use to concentrate when they have difficult information to learn. While the majority of people will fall into all of the different categories at some point, each individual has their own preferred method of learning, their learning style. The most commonly known learning style is accelerated learning, which is a clearinghouse term for individuals whose learning style preference is visual, auditory or tactile. The common theme between these three learning style preferences is that it refers to the primary way an individual takes in information. This process is known as perceptual modality. The field of accelerated learning relies heavily on modality to explain how learners can process information best.

The theory of experiential learning was outlined in Kolb (1976), with the development of a Learning Styles Inventory. This inventory assessed four learning modes: (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation. According to Kolb and Baker (1979-80) the four experiential learning styles are:

The Accommodative Learning Style - you have the ability to learn primarily from hands-on experience. You probably enjoy carrying out plans and involving yourself in new and challenging experiences. Your tendency may be to act on intuition and "gut feel" rather than careful analysis. When a thoughtful approach does not seem to be working out, you will be quick to discard it and improvise.

The Divergent Learning Style - you probably have the ability to view specific situations from many perspectives. For example, you may enjoy brainstorming and small group discussions. You also like to gather information and probably have broad interests. Your tendency may be to watch events rather than participate in them.

The Convergent Learning Style - you have the ability to find practical applications for ideas, concepts and theories. In particular you enjoy situations where there is a single or best answer to a question or problem. You may usually assume there is one best answer and use technical analysis to reveal it. You also may usually prefer to deal with technical issues rather than people issues.

The Assimilative Learning Style - you have the ability to create theoretical models (ideas that predict outcomes and descriptions of how different factor interact). You most likely enjoy inductive reasoning and distil disparate observations into logical explanations. (pp. 11-17)

According to Gardner (1995) learning styles are a general approach to learning that can be applied in any situation, whereas an intelligence is a capacity for a specific content. In this respect, an individual can be "reflective, with music but fail to be reflective in a domain that requires mathematical thinking or that a person is highly intuitive, in the social domain but not in the least intuitive when it comes to mathematics or mechanics" (p. 205).

In 1983, Howard Gardner argued that "there [was] persuasive evidence for the existence of several *relatively autonomous* human intellectual competences" (p. 8) or multiple intelligences. In his initial work, Gardner utilized eight different criteria to identify a list of intelligences. Using these criteria, Gardner initially proposed seven intelligences:

Verbal/Linguistic – ability to understand and manipulate words and languages.

Logical/Mathematical – ability to do things with data.

Visual/Spatial – ability to form and manipulate a mental model.

Bodily-Kinesthetic – ability to process information through the sensations they feel in their bodies.

Musical-Rhythmic – ability to understand, create, and interpret musical pitches, timbre, rhythm, and tones and the capability to compose music.

Interpersonal – ability to interpret and respond to the moods, emotions, motivations, and actions of others.

Intrapersonal – ability to know oneself. (Giles, Pitre, & Womack, 2003)

In 1999, Gardner's added two additional intelligences: naturalistic, which "is seen as someone who recognizes and classifies plants, animals, and minerals including a mastery of taxonomy," and existential, which "encompasses the ability to pose and ponder questions regarding the existence – including life and death" (Giles *et al*, 2003).

Methodology

The teacher of the online business education course, who was also one of the two researchers involved in this study, invited his students to participate in a research study on learning styles and web-based design. Of forty-two students in the course, thirty-one elected to participate.

In the first two months of the 2002-03 school year, participating students were asked to complete a paper-based learning style inventory. This learning styles inventory was broken down into three different sections: accelerated learning style; Kolb's theory of experiential learning; and Gardner's original seven intelligences. After students completed the learning styles inventory, the students' scores

for each of the three measures were calculated. At the end of the course, students' final grades were grouped based on their learning style preferences on the three measures and averaged.

In addition to the learning styles inventory, the researchers also conducted an analysis of the content of the course web-based. This analysis determined the total number of different webpages that the course contained and the different media elements that were included on each of those pages. This analysis was conducted to reveal if the course design may have influenced the students' final grades.

Results and Discussion

The consideration of the three accelerated learning styles provided interesting results. Students were asked to determine their suitability to various statements, then the statements were then broken down into three categories; visual, auditory and tactile; and students were given a score from a low of 8 to a high of 24. The table below illustrates the student averages based upon their scores. The table can be understood to read that there were thirteen students whose highest learning style score was in the visual category. The average final grade of these thirteen students was 69.2%. However, there were only six students' learning style score in the visual category was greater than 80% and they had an average of 71.3%.

Table 1 – Student averages based upon traditional learning style score

	Visual	Auditory	Tactile
Students highest scores	69.2% (n=13)	54.7% (n=9)	57.6% (n=14)
Students scored 20 or above	71.3% (n=6)	45.0% (n=1)	65.7% (n=7)

As it illustrated in the table, there appears to be a pattern that students who were visual learners performed better than those students who were tactile learners. The students who were tactile learners performed slightly better than those students who were auditory learners.

Using Kolb's theory of experiential learning, students were asked a series of word association questions, which yielded results that were transcribed onto a graph. These results were joined to form a circle and the percentage of the circle that fell into each quadrant was measured to determine the students' score for each of the four experiential learning styles. The table below indicates the percentage of that circle that fell into each of the different learning styles. The table can be understood to read that there were six students whose highest learning style score was in the accommodative category and they had an average of 60.8%. However, there were only four students who had more than 40% of their circle was in the accommodative category and they had an average of 59.3%.

Table 2 - Student averages based upon experiential learning style score

Number of students	Accommodative	Divergent	Convergent	Assimilative
Highest percentage	60.8% (n=6)	63.8% (n=15)	71.6% (n=9)	88.7% (n=3)
Above 40%	59.3% (n=4)	62.6% (n=10)	76.4% (n=6)	88.7% (n=3)

The table above indicates that students with the assimilative learning style tended to perform better than students from any of the other three learning styles. In addition, students with the convergent learning style tend to perform better than students from the divergent and accommodative learning styles.

Considering Gardner's original seven intelligences, students were provided with a list of statements and asked to indicate whether the statement was true, sometimes true and sometimes false or false. Each statement was then associated with one of Gardner's intelligences and students were to indicate the number of statements where they had selected true. This provided a measure of 0 to 5 for each of the seven intelligences, with a score of 4 or 5 indicating that students possessed that intelligence. The results are indicated in the following table. The table can be understood to read that there were four

students whose highest intelligence score was in the interpersonal category and those four students had an average of 70.8%. However, there were a total of twelve students' intelligence score in the interpersonal category was a 4 or a 5 (i.e., greater than 80%) and they had an average of 66.5%.

Table 3 – Student averages based upon Gardner’s intelligence score

	Inter-personal	Bodily-kinesthetic	Intra-personal	Logical-mathematics	Musical-rhythmic	Verbal-linguistic	Visual-spatial
Students highest scores	70.8% (n=4)	67.6% (n=9)	92.0% (n=1)	66.7% (n=6)	53.3% (n=9)	58.7% (n=11)	65.7% (n=15)
Students scoring 4 or 5	66.5% (n=12)	64.7% (n=11)	71.0% (n=2)	63.7% (n=15)	59.4% (n=14)	55.7% (n=15)	63.0% (n=18)

While there are few differences in student performance based upon this measure, students who have aptitudes for “Musical-Rhythmic” and “Verbal-Linguistic” appear to be somewhat lower averages than the other five intelligences. It is also interesting there were very few intrapersonal learners in this course, maybe indicating students with this learning style were not comfortable in taking a web-based course.

The consideration of the traditional learning styles is consistent with the findings from the initial study conducted during the CDLI’s pilot phase. Both studies found that students who showed a preference for the visual learning style tended to perform better than students from the other two styles. The consistency of the findings of both studies continued in the consideration of Kolb’s theory of experiential learning. As with the current study, in the initial study five of the seven students who had a final mark of 90% or higher showed a preference to the "Assimilative" and "Divergent" learning styles, while three of the four lowest performing students indicated a preference for the "Accommodative" learning style. Finally, the initial study also indicated that students with the lowest class averages also tended to show a preference for Gardner’s "Musical-Rhythmic" and "Verbal-Linguistic" intelligences.

The consistency in these findings seems to indicate that there is a definite bias in both the design of the web-based courses that are being offered and in the instruction of these courses in the e-learning environment. In terms of the web-based design of the business education course utilized in the follow-up study, a summary of the web-based components contained in that course are provided in Table 4. The table can be read as there were 9 pages in the “Introduction” section. Two of these pages contained a total of five images. There were also three pages that contained a total of three tables. There were no pages that contained interactive items, audio or video components.

Table 4 – Web-based design components of the business education course

	Pages	w/ Images	w/ Tables	w/ Interactivity	w/ Audio	w/ Video
Homepage	1					
Introduction	9	2 (5)	3 (3)			
Unit 1	76	9 (10)	2 (2)	7 (7)		4 (11)
Unit 2	63	3 (3)	2 (1)	6 (6)		1 (2)
Unit 3	80	17 (25)		3 (3)		1 (3)
Unit 4	62	9 (11)		4 (4)		2 (7)
Unit 5	72	16 (32)	6 (7)	4 (4)		6 (15)
Unit 6	31	2 (21)				1 (3)
Glossary	27					
Total	421	59 (107)	13 (13)	27 (27)		15 (41)

The information present in the above table is to be expected, considering the student performance based upon learning style. The students who showed a preference to the auditory learning style and the students

who showed strength for the musical-rhythmic intelligence both had lower class averages than other categories. According to the table above, there were no elements that were strictly audio, even though all of the video elements contained both audio and visual tracks. In addition, the number of pages that contained videos represented less than 10% of the total number of webpages in the course. While the study did not measure whether these students would have performed better had there been additional audio and video components, it indicates that there was a deficiency in the way that the web-based design of the course addressed different learning styles and this may have contributed to the poorer performance for students who had learning preferences in these areas where resources were not provided for that learning style.

Conclusion

It is imperative that educators keep up-to-date with current trends in education that can make a difference in their classroom instruction. According to the Software & Information Industry Association (2001) “educators are beginning to leverage their investment: moving from access to integration mode, and from technology adoption to educational innovation”. Based upon the data that has been presented in this study, there are a number of issues that are raised for educators and instructional designers of e-learning material. The most important of these appears to be that in designing e-learning environments, developers should make sure to include more audio items, as this was an element of web-based design that was deficient in terms of tailoring instruction to a variety of learning style preferences..

There are also issues that are raised for those who teach in an e-learning environment. The most important of these appears to be that e-teachers should attempt to provide additional opportunities for students to interact in a verbal (e.g., audio or text-based) way. “In final analysis, online learning or e-learning isn’t about digital technologies any more than classroom teaching is about blackboards. E-learning should be about creating and deploying technology systems that enable constructive human interaction and support the improvement of all teaching and learning” (Blomeyer, 2002, 19).

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