

Learning Styles and Student Performance in an e-Learning Environment

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Abstract - As e-learning begins to proliferate into secondary schools and is opened up to learners of all abilities, it is important that the effects different learning styles have upon how online instruction is provided are taken into consideration. In this study, students from a secondary-level business education class completed a learning styles inventory to determine their strengths in the traditional learning styles and in Gardner's intelligences. A variety of web-based instructional methods were utilized throughout the school year and the students' overall performance in the course was monitored.

Introduction

Within the walls of a traditional classroom, teachers have become quite adapt at modifying their own instruction to assist the variety of learning styles that the students sitting in front of them possess. However, within a web-based learning environment these 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 proliferate 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/taken into consideration.

While the traditional learning styles (e.g., auditory, visual and tactile) still apply in an e-learning environment, in order to truly design and deliver web-based instruction that is directed to different learning styles, a broader measure needs to be used.

The Study

The Centre for Distance Learning and Innovation (CDLI) began its implementation year in 2001-02 with ten courses being piloted in ten different school districts (i.e., one course per school district). The courses themselves were primarily text-based with some images. Only a select few of the courses contained any multimedia or audio components. Each course was limited to approximately 20 students and many of the students that were selected were "hand-picked" by administrators specifically for this pilot. 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 1:80 and students from all over the province's ten school districts were able to access any of the courses.

In this study, twenty-one students from a Canadian History course (of 21 students) from the pilot year and thirty-one students from an Enterprise Education course (of 42 students) from the following school year completed a learning styles inventory to determine their strengths in the traditional learning styles and in Gardner's original seven intelligences. At the end of the school year, the students' final average was collected and compared to their learning styles inventory.

Web-Based Design and Student Learning Styles

The main purpose of the study was to determine whether the design of the CDLI courses were favorable to one or more different types of learning styles. As mentioned above, the CDLI courses are primary text-based, with about one image for three to five webpages of text. In the two courses considered for this study, neither had more than a half dozen pieces of multimedia and one or two audio components.

According to the Learning Lab at the University of Northwestern Ohio, the description of the three basic learning styles is indicated below.

Visual Learners - you have to see it to believe it

- needs to see it to know it
- strong sense of colour
- may have artistic ability
- difficulty with spoken directions
- over-reaction to sounds
- trouble following lectures
- misinterpretation of words

Auditory Learner - if you hear it, you remember it

- prefers to get information by listening
- needs to hear it to know it
- difficulty following written directions
- difficulty with reading and writing

Tactual Learner - if you can touch it with your hands, you will remember it

- prefers hands-on learning
- can assemble parts without reading directions
- difficulty sitting still
- learns better when physical activity is involved
- may be very well co-ordinated and have athletic ability

The learning style inventory that was administered to students asked them to rate various statement as based upon their suitability to themselves. The statements were then broken down into three categories; visual, auditory and tactile; with each of the possible responses given a weighted value. Students could receive a score from a low of 8 to a high of 24 for each type of learning style.

The table below illustrates the student averages from the Canadian History course based upon the category in which they scored the highest and categories where they scored higher than 75%.

Table 1 – Student averages based upon learning style score for Canadian History

	Visual	Auditory	Tactile
Students highest scores	85.1% (n=14)	79.0% (n=4)	82.2% (n=6)
Students scored 20 or above	87.8% (n=8)	75.8% (n=3)	78.8% (n=4)
Students scored 18 or above	87.5% (n=13)	83.0% (n=8)	84.5% (n=10)

The low number of students and narrow range of marks, due to the administrative selection of students, make it difficult to draw conclusions. However, there appears to be a pattern that students who are visual learners perform better than students who are tactile learners who perform better than students who are auditory learners.

While the sample cohort for the Canadian History is limiting due to its lack of open enrolment, the sample for the Enterprise Education course is slightly larger and much more

representative of the true student population. Table 2 indicates the same measure to the Enterprise Education course.

Table 2 – Student averages based upon learning style score for Enterprise Education

	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)
Students scored 18 or above	65.7% (n=15)	57.2% (n=10)	62.3% (n=17)

The pattern that began to emerge with the Canadian History course is more defined in the Enterprise Education course. Those students who were visual learners performed noticeably better than those students who were tactile learners. The students who were tactile learners performed slightly better than those students who were auditory learners.

Prior to drawing any conclusion consideration utilizing a more detailed measure of learning style is necessary. For the purpose of this study, Gardner’s original seven intelligences were identified to be used.

According to Edwards (1995), each of Gardner’s original seven intelligences is better suited to certain types of computer applications.

Interpersonal Intelligence - Telecommunications programs; programs which address social issues; programs which include group presentation or decision making; games which require two or more players; TV production team approach

Bodily-Kinesthetic Intelligence - Software requiring alternate input such as joystick, mouse, or touch window; keyboarding and word processing programs; animation programs; programs which allow them to move objects around the screen; science probeware

Intrapersonal Intelligence - Computer assisted instruction/ILS labs; instructional games in which the opponent is the computer; programs which encourage self-awareness or build self-improvement skills; any program which allow them to work independently; brainstorming or problem solving software

Logical/Mathematical Intelligence - Database and spreadsheet programs; problem solving software; computer programming software; strategy game simulations; calculators; multimedia authoring programs

Musical-Rhythmic Intelligence - Programs that combine stories with songs; reading programs which associate letter/sounds with music; programs which allow them to create their own song; constructing presentations using CD audio discs, videodisc player, and barcode program; sing along videodisc programs that display work "karaoke" style

Verbal/Linguistic Intelligence - Word processors that allow voice annotations; desktop publishing programs; programs with speech output; programs which encourage them to create poetry, essays, etc.; multimedia authoring; using videodiscs and barcode programs to create presentations; tape recorders; telecommunications/electronic networking

Visual/Spatial Intelligence - Draw and paint programs; reading programs that use visual clues such as rebus method or colour coding; programs which allow them to see information as maps, charts, or diagrams (i.e. charting capability of spreadsheet program; multimedia programs; science probeware

To complete the Gardner portion of the learning styles inventory, students were given 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 for the Canadian History course are illustrated in the table below.

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

	Inter-	Bodily-	Intra-	Logica-	Musical-	Verbal-	Visual-

		personal	Kinesthetic	personal	Mathematics	Rhythmic	Linguistic	Spatial
Students	highest	88.3% (n=3)	85.6% (n=8)	0% (n=0)	80.5% (n=6)	77.0% (n=4)	85.4% (n=7)	82.7% (n=6)
Students	scoring	88.3% (n=3)	86.3% (n=9)	0% (n=0)	86.1% (n=8)	82.2% (n=6)	82.3% (n=7)	88.1% (n=7)

With similar concerns about affects the lack of open enrolment has on the data, there is only one point that can be made based upon this table. Students who had their highest scores in the musical-rhythmic intelligence were the only group to have an average of less than 80%.

The Enterprise Education course, however, had a greater degree of difference between many of the seven intelligences, as indicated in the following table.

Table 4 – Student averages based upon Gardner’s intelligence score for Enterprise Education

		Inter- personal	Bodily- Kinesthetic	Intra- personal	Logical- Mathematics	Musical- Rhythmic	Verbal- Linguistic	Visual- Spatial
Students	highest	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	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 lower than the other five intelligences. Both of these intelligences can be associated with auditory learners, a group which also scored lower than their counterparts. Finally, it is interesting to note that there were no students with the intrapersonal intelligence in the Canadian History course and very few in the Enterprise Education course.

Conclusion

Based upon the data that has been presented in this study, there are a number of issues that are raised for 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.

There are also issues that are raised for individual 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.

Selected Bibliography

Edwards, Jack. "Multiple Intelligences and Technology." *About Face* 10 3 (1995): 4 pages. 08 August 1999 <http://www.firn.edu/~face/about/dec95/mult_int.html>.

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