Does cognitive style affect student performance on a web-based course?

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ABSTRACT

A lot of research has been carried out to assess web-based courses. In many studies the concern has been the students' satisfaction and achievement in web-based courses and traditional face-to-face courses, and the comparison between the two. Other studies have focused on the development of web-based courses to meet the requirements of educational institutes. Studies about students' cognitive styles may be important for the designers of web-based courses because of the potential to enhance learning. However, the relationship between the students' cognitive styles and their satisfaction and achievement has not been researched fully and the implications are inconclusive. The aim of this study is to investigate the relationship between students' cognitive styles, their satisfaction, achievement, and their way of using a web-based course. Cognitive Styles Analysis (CSA) by Riding and Rayner [11] was selected as the instrument to determine whether students were field-dependent or field-independent. Students' attitudes toward using WebCT (Web Course Tools) were measured by a questionnaire specially designed for this intention. Students' activities on WebCT were observed through the tracking system which provided information about students' use of every tool and page on WebCT. The study does not provide data to support a relation between students' cognitive style and their use of online learning environments such as WebCT. However cognitive style seems to have an effect on student achievements.

KEYWORDS

Web-based learning; WebCT, Cognitive styles, Students' performance.

1. INTRODUCTION

Most Most of the universities in the UK are using technology to develop courses that meet students' educational needs and goals [10]. Technology features can enhance learning outcomes by facilitating efficient delivery of instructional strategies and by supporting certain activities such as cognitive problem-solving and decision-making processes of the learner [1]. Universities are implementing different types of technology-supported learning. This study will focus on web-enhanced courses only. Web-enhanced courses are traditional face-to-face course which include web-related materials. Web-enhanced courses usually adopt a course management system e.g. WebCT (Web Course Tools) [14].

WebCT is an important application for higher education. It has been developed by Murray Golderg, a faculty member at the University of British Columbia [2, 16]. WebCT is an integrated set of educational and management tools and an important provider of e-learning programs. It is specifically used for the design and development of teaching and learning materials. WebCT is mainly used to create sophisticated World Wide Web-based educational environments either by creating entire online courses, or simply by publishing materials that supplement existing courses. Users of WebCT do not need a lot of technical expertise as all content is accessible via a standard Web browser[16].

Technology has the possibility to enhance and transform teaching, but it can also be used incorrectly or in ways that may interfere with learning so it is important to know how we can achieve effective learning online [13]. Different ways can be used to measure the effectiveness of web-based courses. Therefore studies in distance education differ in what they use as evidence of online course effectiveness. Wells [17] studied the effect of an on-line computer-mediated communication course, prior computer experience and internet knowledge and learning styles on students' internet attitude.

Other research [12] investigated the relationship between student perceptions of others in an online class and both affective and cognitive learning outcomes. They demonstrated the significance of student-student as well as teacher-student interaction in online classes. They highlighted the importance of instructor presence and interaction among students to attitudes about the class. They believe that interaction between students is an integrated part of the class and that instructor should encourage and support the interaction. Thought, facilitating interaction, is time-consuming and often demanding.

Psychological studies have shown that personal beliefs/opinions about learning and environmental preferences

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affect learning behaviours. However, these learner characteristics have not been widely discussed in the web-based context [19]. "Cognitive style is seen as an individual's preferred and habitual approach to organising and representing information" [11, p. 8]. For example some people prefer learning by being told (e.g. lecture); others prefer learning by exploration (e.g. searching on Internet).

Research has been conducted to find the relationship between different cognitive style and web-based learning and design. Graff [4] investigated the interplay between cognitive learning styles and the effectiveness of online courses in delivering instructional content. Students were categorized on a range from wholistic to analytical. Wholistic learners view ideas as complete wholes and are unable to separate the ideas into discrete parts. In contrast, analytical learners are able to comprehend ideas in parts but have difficulty in seeing the complete picture. Along another axis, learning styles were arrayed from verbalizers to imagers. Verbalizers do well with text-based material, whereas imagers deal well with spatial data. The results showed that analytics performed better than the wholistics in the long-page format ,which was 11 pages long with much content on each page. That is because Analytics were able to learn the content in parts, and could integrate the information. Also, imagers were superior to verbalizers on the recall test in the short-page format, which contained 23 pages of content with little on each page. The study concluded that Web-based learning environments should be matched to the cognitive style of the user.

In the same perspective Summerville [15] stated that matching cognitive style to teaching environments may be important because of the potential to enhance learning. However, at this time, the relationship between matching cognitive style and learning has not been researched fully and the implications are inconclusive, especially for hypermedia learning environments.

In another study, Jelfs and Colbourn [16] studied students' learning approaches within a group and how this affected their adoption or rejection of the electronic medium. They found weak correlations between deep, strategic and surface approaches to learning and perception of Communication and Information Technology. They said that measures of the deep, strategic and surface approaches to learning indicate potentially interesting relationships. They also suggested that to improve student interest in the use of computer-mediated communication and to motivate students then it has to be relevant to their course of study and that teaching staff have to also be active in their use of the technology. Students will quickly lose interest if they think that teaching staff are not paying attention to their students' contributions.

One of the most widely investigated cognitive styles with respect to student learning is field dependence [3]. Field dependence refers to an individual's ability to perceive a local field as discrete from its surrounding field [18].

2. PURPOSE OF THE STUDY
The aim of this study is to investigate the relationship between students' cognitive styles, their satisfaction, achievement, and their way of using a web-based course.

3. RESEARCH METHODS
The study was conducted at Brunel University, UK. All undergraduate and taught postgraduate courses delivered by the School of Information Systems, Computing and Mathematics at Brunel University are supported by WebCT.

3.1 Participant
There were 72 students taking the observed module. 51 students (23 females and 28 males) respond to both attitude questionnaire and cognitive style analysis test CSA (Ridding). The age of respondents ranged between 18-20 years old.

3.2 Research instruments
A questionnaire was designed to measure students' attitude toward WebCT. A five point Likert scale type of question was used in the questionnaire. The Likert scale is highly used in similar studies to assess respondents' attitude as for example: [5,17]. The questionnaire contained 25 statements to which students can show their agreement or disagreement.

Information on students' use of WebCT throughout term time was obtained from the tracking system. The tracking system provides information on how many times each student visited each page in WebCT and how much time they spent exploring it. Moreover, the module leaders' approaches to using WebCT were explored by monitoring the web pages of their modules. These observations provided information about how they designed their modules, which tools they used, and how often they answered the students' questions.

In this study, the level of Field Dependence has been investigated along the cognitive style dimension. Field Dependence can be measured by the number of instruments that have been developed such as the Group Embedded Figures Test (GEFT) [18] and the Cognitive Styles Analysis (CSA) [11]. The CSA offers computerized administration and scoring. Therefore, the CSA was used as the measurement instrument for Field Dependence in this study.

3.3 Procedure
Students' cognitive styles were determined using the CSA test instrument during the term time in one of their lap sessions. Statistical data about students' use of WebCT was collected weekly. The statistical data was mainly in numbers giving information about how many times each student visited the web page for a module. Moreover, it provided records about how many times a student read or posted on the communication board. Also, it gave information about how many times they visited each page within a module and how much time they spent on them. In order to measure students' attitude toward WebCT a questionnaire was submitted on paper to the students at the end of the lectures on the module before the examination period began.

Students' general uses of WebCT were measured by the number of times each student accessed WebCT pages or used the discussion board for the observed modules. Students' achievement was measured by their grades (coursework and exam). Students' attitudes towards WebCT were measured by using the designed questionnaire. The questionnaire was submitted to the students during the term time in one of their lap sessions after they continued the CSA test.

Table1: The mean of students' attitude, use of WebCT in relation to their FD/FI cognitive style

FD_FI	Attitude	Time	Read	Post	Assessment	Content folder	Files	Total	CW	Exam
Field dependent	3.43	22.24	121.37	.19	9.00	117.19	184.38	56.00	63.19	49.06
Intermediate	3.49	21.89	178.00	.50	7.85	120.05	189.95	56.80	60.80	52.60
Field independent	3.44	31.75	73.13	.27	7.07	122.87	207.87	44.27	49.47	38.73
Total	3.45	24.90	129.39	.33	7.98	119.98	193.47	52.86	58.22	47.41

(Time (hours): overall time spent using WebCT; Read/Post: number of messages read/posted in the communication board; Assessment: number of times students practiced using the online tests. Content folders: number of time students accessed the lecture slides folder. Files: number of times students accessed available files such as study guide, coursework slides, and seminars questions and answers. Total: overall grades. CW: coursework grades. Exam: exam

4. RESULTS

31.4% of the students found to be field dependent, 39.2% intermediate, 29.4% field independent.

Differences were found between these three groups in terms of attitude and the way they used WebCT. Table 1 shows these differences.

In order to find out whether or not these differences are statically significant, an ANOVA test was carried out. Table 2 shows the ANOVA results for students' attitude in relation to cognitive styles. The test results (as shown in table 2 below) indicate that cognitive style does not appear to be a significant factor in students' attitude towards WebCT

Table 2 ANOVA of the students' attitude towards WebCT

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.037	2	.018	.114	.893
Within Groups	7.780	48	.162		
Total	7.817	50			

The next analysis to be carried out looked at students use of WebCT. Table 3 shows the ANOVA results for students' use of WebCT, number of times each students accessed WebCT and the total time they spent on WebCT. The results indicate that cognitive style does not appear to have a significant effect on students' patterns of use when using WebCT.

Table 3 ANOVA of the students' use of WebCT

		Sum of Squares	df	Mean Square	F	Sig.
Sessions	Between Groups	2773.693	2	1386.847	.406	.669
	Within Groups	164131.48	48	3419.406		
	Total	166905.17	50			
Time	Between Groups	998.787	2	499.394	1.502	.233
	Within Groups	15961.826	48	332.538		
	Total	16960.613	50			

The next analysis to be carried out looked at student achievement. Table 4 shows the ANOVA on the final exam, course work, and overall grades obtained by the students. The dependent variable is students' cognitive style. There were significant difference fund between performance in the exam, coursework and overall grades ($p<0.05$). Field dependent students got better grades in coursework and written exam than field independent students. However, in the coursework computerized test, filed independent students got better grades than field dependent students.

Table 4 ANOVA of the students' grades

		Sum of Squares	df	Mean Square	F	Sig.
CW	Between Groups	1677.257	2	838.628	3.969	.025
	Within Groups	10143.371	48	211.320		
	Total	11820.627	50			
Exam	Between Groups	1711.682	2	855.841	3.360	.043
	Within Groups	12226.671	48	254.722		
	Total	13938.353	50			
Total	Between Groups	1575.906	2	787.953	4.163	.022
	Within Groups	9086.133	48	189.294		
	Total	10662.039	50			

5. DISCUSSION AND CONCLUSION

Based on the students' responses to the attitude questionnaire the overall attitude of the students toward using WebCT was positive. This result backs up much research in the area; however, this study does not provide evidence that students' cognitive style affects their attitude towards using WebCT.

Field-dependent students were found to spend less time using WebCT than field-independent students. Although, field-dependent students used the communication board more than field-independent students, this could be explained by the [9] study which indicated that field-dependent students rely on others for information, guidance, and maintenance of attitudes. At the same time field-dependent students accessed the available files on WebCT more often than field-independent students.

The differences between the three groups (FD, FI, and Intermediate) are clear however they are not statically significant. This leads to the conclusion that cognitive style seems not to be a significant factor in students' attitude toward WebCT. Furthermore, cognitive style has not been found to be a significant factor the in students' way of using WebCT (the number of times each students visited WebCT, time spent, number of pages visited, and posted or read messages). These results back up the findings from studies such as [8]. Students' Field Dependence does not have an impact on their learning performance in WebCT [8].

The results showed a significant difference between the means of the students' grades, which suggests that students' cognitive styles did affect their achievement. The results also show that field-dependent students achieved better marks in the course exam and their coursework. We can't connect this result to the students' use of WebCT; however, it can be explained by the subject area of the observed module subject.

This study found that students' cognitive styles seem not to be a significant factor in students' attitude toward WebCT. Also, the results suggest that students have positive attitude towards using WebCT regardless of their cognitive styles. Moreover, field-independent students did not differ significantly from field-dependent students in their way of using WebCT (the number of times each student visited WebCT, time spent, number of pages visited, and posted or read messages). In other words, students with different cognitive styles are able to learn equally well on WebCT online courses.

6. REFERENCES

[1] Alavi, M. and Leidner D. E. 2001. Research commentary: Technology-mediated learning. A call for greater depth and breadth of research. Information System Research. 12, 1, 1-10.

[2] Burgess, L. A. 2003 WebCT as an e-learning tool: a study of technology students' perception. Journal of Technology Education, 15 (1) Fall, pp. 6-15.

[3] Chen, S.Y., Ghinea, G. & Macredie, R.D., 2006. A cognitive approach to user perception of multimedia quality: An empirical investigation. International Journal of Human-Computer Studies, 64(12), 1200-1213.

[4] Graff, M., 2003. Individual Differences in Sense of Classroom Community in a Blended Learning Environment. Learning, Media and Technology, 28(2), 203

[5] Hisham, N., Campton, P. & FitzGerald, D. (2004) A tale of two cities: A study on the satisfaction of asynchronous e-learning system in two Australian universities. In proceeding of the 21st ASCILITE conference, December 5-8, 2004, Perth, Western Australia, pp. 395-402.

[6] Jelfs, A. & Colbourn, C., 2002. Do Students' Approaches to Learning Affect Their Perceptions of Using Computing and Information Technology? Journal of Educational Media, 27(1), 41-53

[7] Jones, G. H. and Jones, B. H. (2005). A comparison of teacher and student attitudes concerning use and effectiveness of web-based course management software. Educational Technology & Society, 8, 2, 125-135.

[8] Lu, J., Yu, C. & Liu, C., 2003. Learning style, learning patterns, and learning performance in a WebCT-based MIS course. Inf. Manage., 40(6), 497-507.

[9] Mcleod, D. B. and Adams, V. M. 1979 The interaction of field independence with discovery learning in mathematics, Journal of Experimental Education 48 (1), pp. 32–35.

[10] O'Neill, K., Singh, G. and O'Donoghue, J. 2004. Implementing eLearning Programmes for Higher Education: A Review of the Literature. Journal of Information Technology Education. 3, 312-323.

[11] Riding R, J. & Rayner, S. 1998. The Learning Enhancement Programme; Cognitive Style and Effective Teaching, (second edition). (Birmingham, Learning and Training Technology)

[12] Russo, T. & Benson, S., 2005. Learning with Invisible Others: Perceptions of Online Presence and their Relationship to Cognitive and Affective Learning. Educational Technology & Society,, 8(1), 54-62.

[13] Salter, G. 2003, Comparing online and traditional teaching- a different approach. Campus-Wide Information System, 20 (4) September, pp. 137-145

[14] Sivo, S. A., Pan, C. C. S. and Hahs-Vaughn, D. L. 2007. Combined longitudinal effects of attitude and subjective norms on student outcomes in a web-enhanced course: A structural equation modelling approach. British Journal of Educational Technology. 38, 5, 861-875.

[15] Summerville, J.B., 1998. The Role of Awareness of Cognitive Style in Hypermedia. Available at:http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED423865 [Accessed May 5, 2009].

[16] Volery, T., & Lord, D. 2000 Critical success factors in online education, the international. journal of educational management, 14 (5) August, pp. 216-223

[17] Wells, J.G., 2000. Effects Of An On-Line Computer-Mediated Communication Course, Prior Computer Experience and Internet Knowledge, and Learning Styles On Students' Internet Attitudes Computer-Mediated Technologies and New Educational Challenges. Journal of industrial teacher education, 37(3), 22-53.

[18] Witkin, H. A., Moore, C.A., Goodenough, D.R., & Cox, P.W. (1977) Field-dependent and field-independent

cognitive styles and their educational implications. Review of Educational Research, 47(1), 1-64

[19] Yang, F. & Tsai, C., 2008. Investigating university student preferences and beliefs about learning in the web-based context. Comput. Educ., 50(4), 1284-1303.