

Factors affecting e-learning for achievement

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Abstract

E-learning is an essential trend in education for the 21st century. Because the nature of e-learning is different from the traditional learning, an in-depth research on factors affecting e-learning would help instructors to improve their teaching effectiveness, and the results can also benefit e-learning players for their operation and management of cyber universities (digital schools). This study adopted methods combining both qualitative and quantitative. The subjects were 70 students taking "Computer Networks and the Internet" course in the masters program offered over the Internet by National Sun Yat-sen University in Taiwan. The study found that e-learning provided a good learning achievement and students' background has no significant influence on learning achievement. However, study habits and class attendance with learning achievement were found to have positive and significant relation. In addition, we survey influencing factor for more understanding of the learner in factors that affect students' success in Web-based learning. The most significant factors according to the influence level are: 1. Job factor, 2. Internet transmission speed and stability, 3. Diligence, 4. Instructors' online lecture delivery software.

1. Introduction

The rapid information technology advanced in the last decade, especially the rapid proliferation in use of the Internet and the World Wide Web have indeed transformed the way we live, work, communicate, and learn. The next major application for the Internet will be in education (Chen, 2000). For example, media technologies are already changing the ways in which distance education is conducted, enabling learners to receive and interact with educational materials and resources, as well as engaging with teachers and peers in ways that previously may have been impossible (Kirkwood, 2001). Some research studies have indicated that the various modes of interactive distance learning technologies give rise to positive change in the instructional and learning processes when compared with

earlier distance learning systems (Katz, 2002; Wilson & Whitelock, 1997; Yablon & Katz, 2001). Moreover, some studies have emphasized that Web instruction and learning is a fairly new and unknown domain, a growing number of courses delivered over WWW are influencing more and more students (Jiang, 1998). Thus it is important to understand how this new technology can effect learning when it is used by different types of learners (Parson, 1998; Shih, 2000). Furthermore, we need to better understand the learning factors that influence student success in Web-based learning (Shih, 2000).

Kendall (2001) showed that there is a strong correlation between higher participation and the achievement of higher grades. Jones & Jones (1997) reported that details of learners' actions whilst working asynchronously with on-line materials can be recorded automatically in log files. Over a period of time, each learner exhibits a certain pattern of behavior (Hwang & Li, 2002). Some scholars analysis log files and found that students with better attendance (number of times logged into the class) and reading depth (number of time browsing the material) in courses had better achievement (Lin & Chen, 2000; Liu, 2000). However the study of Yang and Chai showed that no obvious effect on achievement from students' learning activities such as times of log in or participation in discussion, and instead these only affected probabilities of whether students felt e-learning was helpful (Yang & Chai, 2000).

Based on this literature review, background, learning strategies, academic self-concept, study habit, attitude, satisfactory level, and devotion of study (log files) seem to be associated with achievement. The factors that influence student achievement can be categorized into four aspects as follows: background, characteristics, satisfaction, and devotion of study. However, some subjects in those studies mentioned above were students in traditional teaching/learning environments, whereas others received distance learning through mail, radio broadcasting or TV. Therefore, our study focused on learning achievement of web-based courses.

This study explores the factors influencing students' success in web-based courses. It can provide a guidance for potential learners to decide if they are ready for

enrolling e-learning programs and it can also help instructors to improve their course design and implementation. Moreover, it can help e-learning operators and educators to understand those key issues and solutions for promoting and running cyber-universities. The study analyzed the relationships between students learning achievement and the following variables: study habits, academic self-concept, e-learning attitudes, self-belief, satisfactory level in instruction, satisfactory level in e-learning environment, class attendance, reading depth, and selected background data. To identify those most influential factors a survey from students is conducted for analyzing key factors.

2. Method

This research adopted analysis methods combining both qualitative and quantitative and with an attempt to pursue e-learning achievement influence factors. We use information gathered from three different periods of which pre-learning, learning, and post-learning in order to analyze subjects' background, characteristics, devotion of study, etc.

2.1. Participants

The subjects of this research were students enrolled in the course of "Computer Networks and the Internet" in the first semester of 2000 (9/2000-2/2001) of NSYSU Cyber-University's (<http://cu.nsysu.edu.tw>) master credit programs. The learning objective of this course is for students to understand the basic concepts and operational principles of computer Internet and to be familiar with the protocol of TCP/IP and its future development. The enrollment of the course subtracted those who did not sit for exams, complete a group project and questionnaires; were 70 effective research subjects.

2.2. Instruments of evaluation and data collection used

The collected data includes learners' pre-test and post-test about their computer networks and Internet knowledge, results of questionnaires, students' learning behavior recorded in the web-based learning system, and various scores for achievement. The pre-test and post-test are multiple-choice questions about computer networks and Internet knowledge with the same level of difficulty for the selected questions. As for the questionnaire, there are three parts included. The first part of the questionnaire is a set of close-ended questions including students' background, characteristic, and satisfaction information. Characteristic and satisfaction questions adopt Likert five-point scale and referred questions are coming from

the literature (Kumar, 1999; Shih, 2000). The questionnaire's retest reliability is ($r=.708$, $p<.01$). The second part of the questionnaire is a survey for identifying key influential factors which are multiple-choice questions. The third part of the questionnaire is open-ended questions for students learning achievement. An example of questions like how about your network professional knowledge. The questionnaire has been reviewed by domain expert before conducted. The questionnaires were conducted during the final exam to increase the percentage of returned questionnaire.

For data analysis, quantitative information is analyzed using the SPSS software, including t-test, ANOVA, and multiple linear regression. Then for qualitative information, we adopted interpretive analysis methods. To organize the qualitative information more efficiently and facilitate a detailed comparison, we properly coded the gathered information after initial reading. For example, 7267 standards for the student ID number. The original file was read repeatedly to compare the consistency, furthermore, collected data was inspected and discussed with the course instructor and other researchers to increase the actuality and correctness of the interpretation.

3. Results and discussion

The analyzed items include (1) the background information of the subjects: gender, age, residence, marital status, occupation, education, major, etc.; (2) characteristics of the subjects: e-learning attitudes, study habits, academic self-concept, learning strategies, etc.; (3) degree of satisfaction with instructor's teaching and Internet access environment; (4) students' devotion of study measured from the online learning activity logs recorded by the web-based learning system; (5) survey affecting factors from students.

3.1. Learning achievement

With respect to learning achievement, we can see from the pre-test and post-test results, students' computer networks and Internet knowledge had a significant increased. The statistical t-test shows a significant difference ($t=7.689$, $p<.05$, $df=55$) between the pre and post test results. For the students' grades, the class average score is 80; students who failed (below 70) comprised 14% and students who got over 90 comprised 13%. This research also conducted qualitative analysis of 70 open-ended questionnaires, some critical results described here: (1) Regarding development of Internet professional knowledge, for example, one student said that "this course offered me so much new knowledge from the basic transmission methods to the Internet applications and I learnt the computer networks

knowledge both in theory and technology" (7201). Another student said that "they had gotten complete Internet-related knowledge through this class" (7175). (2) Regarding help to work professions: one student said that "they could now understand solve the problems occurred in their company networks" (7275); another student said that "it had been a great help for him to do company Internet deployment and management planning" (7150). (3) Regarding the interaction and group cooperative learning: one student said that "there were four team members although we all lived in different places, but I was so touched from our cooperation experiences as it was so refined and rewarding; we were able to communicate and discuss instantly on the net while we encountered problems; I felt that this was one of the most unforgettable learning experiences in my life" (7201). From the result of questionnaires and students' average score, we found that this class had a good learning achievement. The following sections introduce background information about the subjects and some of our analyzed results.

3.2. Research Subjects

The ratio of male to female students is about 6:4 and 49% of students is between 31~40 years old. 59% of students are full time employee with jobs related to information technology. The above information matched e-learning students' characteristics published by the Taiwan Learning Trend web site (Chan, 2001); although the average age of our subjects seems to be more older. About 66% of the students don't have an information science related major. With 66% of students live in southern Taiwan and 60% of students attending the class are to learn new skills and knowledge. 46% of students had left schools for over 9 years. About 76% of students are the first time to select e-learning courses for their continuing education. With 71% of students had taken basic computer concepts classes, but only 33% of students had taken classes related to the Internet. The detail background information is showed in Table 1.

3.2.1. Factor analysis. An exploratory principal components factor analysis has been conducted to assess the factor validity of the instrument in this study. We analyzed information about dimension(D), factor name, variable, loading(L), eigenvalue(e), and alpha coefficients(α). The rotated factor solution met the following three criteria: variable loadings is greater than 0.35, factors exhibited eigenvalues is greater than 1.0, alpha coefficients is above 0.5.

3.2.2. How students' achievement differed by their background information. The descriptive statistics

(mean and standard deviation) for learning achievement were computed for each of the variable as shown in Table 2. The study analyzed statistical t-test between learning achievement (students' grades) and the following

Table 1. Percentages of participants by gender, age, occupation, etc.

Variable	Item	Percentage
Gender	Male	64%
	Female	36%
Marital status	Married	54%
	Single	46%
Major	Information-related	34%
	Not information- related	66%
Residence	Southern Taiwan	66%
	Central Taiwan	10%
	Northern Taiwan	23%
	Eastern Taiwan	1%
Age	21-30	34%
	31-40	49%
	41-50	16%
	51-	1%
Job status	Information-related	59%
	Not information- related	39%
	Unemployed	2%
Education	Master	14%
	College	64%
	Junior College	21%
Occupation	Full time student	3%
	Part time student	4%
	Full time employee	86%
	Part time employee	7%
Motivations	Skills and knowledge required for jobs	19%
	Getting academic degree	21%
	Personal interests in learning new things	60%
Years after graduation	1-2	8%
	3-4	16%
	5-6	24%
	7-8	6%
	9-	46%
Distance learning experience	Yes	24%
	No	76%
Taken basic computer concepts courses	Yes	71%
	No	29%
Taken Internet related courses	Yes	33%
	No	67%

Table 2. descriptive statistics (mean and standard deviation) for learning achievement by gender, age, occupation, etc.

Variable	Item	Mean	Std.
Gender	Male	74.40	7.88
	Female	74.44	12.09
Marital status	Married	78.06	10.25
	Single	81.03	8.41
Major	Information-related	79.37	9.94
	Not information- related	79.45	9.39
Residence	Southern Taiwan	79.35	9.44
	Central Taiwan	85.86	5.06
	Northern Taiwan	76.47	10.38
	Eastern Taiwan	84.65	-
Age	21-30	76.90	8.89
	31-40	81.82	9.65
	41-50	77.76	9.81
	51-	76.70	-
Job status	Information-related	79.57	10.34
	Not information- related	79.38	8.53
	Unemployed	77.03	7.74
Education	Master	80.97	10.43
	College	78.67	9.57
	Junior College	80.65	9.10
Occupation	Full time student	70.48	6.12
	Part time student	73.73	14.70
	Full time employee	79.51	9.31
	Part time employee	85.30	7.48
Motivation	Skills and knowledge required for jobs	83.58	7.55
	Getting academic degree	79.82	10.49
	Personal interests in learning new things	77.99	9.50
Years after graduation	1-2	82.16	8.79
	3-4	76.34	8.64
	5-6	78.21	10.13
	7-8	73.74	17.55
	9-	81.32	8.27
Distance learning experience	Yes	83.31	5.72
	No	78.18	10.17
Taken basic computer concepts courses	Yes	79.84	9.65
	No	78.39	9.31
Taken Internet related courses	Yes	81.86	81.86
	No	78.23	78.23

variables: gender, marital status, study major. There were no significant differences. Statistical one-way ANOVA were conducted between learning achievement and the following variables: residence, age, job status, education,

occupation, motivation, years after graduation. However, no significant differences were found. Statistical t-test was conducted between learning achievement and the following variables: distance learning experiences, having taken basic computer concepts courses, having taken internet related courses. The results showed no obvious differences.

We found that different background of students had no significant differences in learning achievement. However we can find some information from this data. The average score of the married people (80) is higher than those who are single (78). Previous studies also have pointed out that married people have better reading habits and it have a positive impact on learning achievement (Kumar, 1999). With regard to ages, people between 31-40 have the highest scores. Those who currently working for information-related jobs have the highest average score, although the difference with non-information related jobs is not much. In terms of motivation, the students motivated by job requirement have higher average score than the other categories.

3.2.3. Relationship of e-learning students' academic achievement to characteristic, satisfactory, and devotion of study. The factors of this study, characteristic (study habit, e-learning attitudes, learning strategies, academic self-concept, and self-belief), satisfactory (satisfactory degree with environment and satisfactory degree with instruction), and devotion of study (class attendance, and reading depth) were entered into the regression model. The dependent variable is student achievement (students' grades). Table 3 presents the results of the stepwise multiple regression analysis, we know that study habit and class attendance are the significant determinants of academic achievement. The result from the analysis revealed that a total of 48.23% of the variance in student achievement is accounted by a combination of two significant variables. The regression equation is $Z = 3.51448Z_1 + 0.051231Z_2$, (Z: academic achievement, Z_1 : study habit, Z_2 : class attendance). There is a positive and significant relationship between the academic achievement and class attendance of the students. A positive and significant relationship is indicated between the students' academic achievement and their study habit.

Table 3. Stepwise multiple linear regression.

Independent variable	R ²	R ² change	Beta	t-value
Class attendance	0.3802	0.00	0.05123	5.53***
Study habit	0.4823	0.10	3.51448	3.97**
Self-belief	0.5062	0.02	-2.73331	-1.79
Adjusted R ²			0.4795	
F		22.55***		

n=70; **:p<0.01; ***:p<0.0001

3.2.4. Survey influential factors from students. For adult students, it is not surprising that factors including work commitments (Eppler & Harju, 1997; Yamauchi & Li, 1993), family orientation (Yamauchi & Li, 1993) and learning situation characteristics like a supportive home environment (Hough, 1994) can have an effect on the level of their achievement. Their studies can be affected by such things as domestic organization and family and domestic interruptions (Gandhe, 1998; Lunneborg, 1994; Parer, 1988), and even by noise levels in the home when they are trying to study (Effeh, 1991; Taplin, 2001). According to the 1000-students survey on the most frequent e-learning problems by the Open University of England in 1993, the top four rankings are 1. lack of time, 2. unable to concentrate, 3. family obligations, 4. not knowing how to make the best of time and plan (Huang, 1999).

Through the literature reviewed and concluded findings from the open questionnaires, we sum up a list of related influential factors. Survey influential factors from students. The results according to influence level are: 1. Job factor, 2. Internet transmission speed and stability, 3. Diligence, 4. Instructors' online lecture delivery software, 5. Course content material, 6. Classmate interaction, 7. Quality of teacher's lecture, 8. Interaction with teacher and TAs, 9. Family factors, 10. Teaching methods, 11. Self-anticipate, 12. Functions of Cyber-University system, 13. Internet access expenses. Among the top four influence factors, two of them are personal factors. Hence personal factors are key elements affecting e-learning achievement. Hence, it is very important to know how to help students to cope with those obstacles they faced in e-learning. The other two influence factors about environment, we believe that following the getting popularity of broadband Internet and improved multimedia browsing tools, these two disadvantage factors can be eliminated from affecting learning achievement.

5. Conclusion and suggestion

According to the analyzed results described above, we found that students' background information (gender, marital status, majors, residence, age, occupation, education, job status, motivation, years after graduation, distance learning experiences, and taken basic computer concepts and internet related courses) have no obvious influence on e-learning achievement. Students' academic self-concept, learning strategies, e-learning attitudes, self-belief, environment satisfactory, instruction satisfactory and reading depth have no significant impact on learning achievement too. However, study habits and class attendance have clear effects on learning achievement.

Therefore, students tend to have good grades regardless of what their occupation, education and gender are. No matter how far away they live and what computer literacy level they are, as long as they are urging for learning new knowledge, they can keep up with teachers' class schedule, concentrate without unnecessary interruptions, and participate actively in online learning classes.

We suggest that teachers should encourage their students to participate often for online learning activities. In addition, teachers should foster students to cultivate good study habits, help students to make good use of their time for online study and urge them to catch up class schedule. The web-based learning system should provide a schedule planner and reminder for students. Teachers can send out e-mails for encouragement or passing a warm regard if students were passive in class activities involvement or some of them had been off the net for several days.

Among the top four most influential factors, two of them are personal factors. So personal factors are obviously key elements affecting e-learning achievement. Therefore it is important to foster active learners and provide a positive and effective supporting system, including for example, a 24-hour problem-solver, an interactive cooperation environment, learning manuals or online learning instruction, actual or virtual learning groups or center, as well as nearby learning resources such as library, lab, instrument/equipment or communication network (Robinson, 1995; Huang, 1999).

In conclusion, we found key influential factors for e-learning achievement can be divided into personal factors and environmental factors. For environmental factors, with advancements in technology improvement on network bandwidth, mature and cheap computer equipments, learning management system and proper regulations, we believe that these external factors will no longer affect learning achievement. Therefore, the most influential factors will turn out to students and teachers themselves. With great efforts from all sectors of society, e-learning will be a future main-stream modality for learning and even be an optimal choice for people's lifelong learning.

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7. References

[1] Agarwal, R. & Day, A.E. (1998) The Impact of the Internet on Economic Education. Journal of Economic Education, 99-110.

[2] Alexander, S. (1999) Teaching and Learning on the World Wide Web <http://www.scu.edu.au/sponsored/>

[ausweb95/papers/education2/alexan](http://www.scu.edu.au/sponsored/ausweb95/papers/education2/alexan), Institute for Interactive Multimedia, University of Technology, Australia.