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Chen-Chung Huang
Tamkang University

Ching-Yi Wu
Tamkang University

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Comparing the student's learning performance between the web-based learning and the conventional learning---A study on a software package teaching

Chen-Chung Huang
Department of Information Management
Tamkang University, Taipei, Taiwan
cchuang@mail.im.tku.edu.tw

Ching-Yi Wu
Department of Information Management
Tamkang University, Taipei, Taiwan
jerna@mail.im.tku.edu.tw

Abstract

To use information technology to improve learning processes is an important issue for the educator. Since the network technology as well as web-based system get more and more flourishing, it will be a good trial for the educator to provide an asynchronous learning platform on the Internet. In this article, we first constructed a web-based system on teaching Microsoft Word. Then, we tried to experiment on this new-fashioned learning method by dividing the subjects into two groups. One group of the subjects could use the browser to access the learning materials from the server, and the other group took the conventional learning processes in the classroom. A 10-week experiment was conducted to compare the student's learning performance between these two clusters. Two major findings are gotten in this study. First, there is no significant difference on learning performance between them. Secondly, the student's learning confidence in the web-based group is significant higher than the confidence of the counterpart.

Keywords: Web-based System, IS Education, Asynchronous Distance Education

1. Research Background

With the IT evolution, computer-based training (CBT) becomes a trend of education. Due to the wide spread application of the multimedia and the network technology on CAI, it becomes a hot issue to use the Internet as a new teaching platform. Hartman (et al., 1995) applied the computer network on a composition writing class, their findings indicated the interaction with teacher on the group with network assistance was significant greater than conventional counterpart. Besides, they also found that the interaction with computer mediated communication (CMC) was greater than the face-to-face communication. McIntyre and Wolff (1998) conducted an experiment in the C programming course by taking WWW interactive learning as an independent variable and found that WWW interactive learning had a significant enhancement to the classroom learning. Chao (1998) compared the Instructional-based and Internet-based teaching methods on the sexual health knowledge and discovered that the latter method was better than the former one. Tiffin and Rajasingham (1999) carried out an experiment to evaluate the efficiency and effectiveness of a virtual space distance education system called HyperClass, a platform implemented on the internet to connect the Waseda University and Victoria University of Wellington. The experiment result showed that HyperClass was useful for distance learning.

Web-based learning, uses a network learning system via WWW to simulate the real teaching

activities such as the instructor’s teaching, holding an exam, assigning homework, handing in assignments, taking part in a discussion, attending an exam and so on. Teachers and students can connect the system via Internet despite the constraints of time and space (Hong, 1999; Shyu, 1998; Hiltz, 1997). Shyu (1988) discussed the learning effect on network learning system via the Internet, and he concluded that network learning processes indeed helpful to the student. Hong (1999), a professor of National Taiwan University, implemented a network learning system via the Internet about the course of Business Administration 3 years ago and discovered that the learning efficiency was excellent. Due to lacking experimental research on this field, it will be an interesting to compare the learning performance of this new-fashioned method with the result of the classroom learning. Besides, in Coggins’s (1988) research showed that the student’s learning style was a significant factor to affect learning persistence for educational programs delivered remotely. Meanwhile, Bostrom et al. (1990) indicated that individual differences would influence the student’s learning process and outcomes. In this paper, we will first implement a web-based system for students to learn Microsoft’s Word package via the Internet using the courseware developed by professor Hong. Then, we assigned two groups of subjects, one for learning this system and the other for learning in the classroom. In the same time, for the learning style of students may affect the learning performance, we will also include this variable in our research framework.

2. Literature Review

Bostrom, et al. (1988) developed a research framework for end-user training to assume that the interactions among the target system, the training methods and the individual difference would affect the training outcomes. Figure 1 shows the research model proposed by Bostrom. Central to this research framework is the notion that users form mental models of systems with which they interact. A user’s mental model is his/her internal representation of the system structure and function that provides explanatory and understanding power (Moran, 1981). The mental model formed through multiple mappings (e.g. mapping via training or usage and so on) would influence the training outcomes. On the training method aspect, Bostrom represented the training method in two dimensions, mental model and method employed. The former attached importance to the concoction and presentation of materials, and the latter emphasized the processes of training. On the other hand, Bostrom considered the target system would influence the learner’s attitude to use, especially on the human-machine interface. In addition, they argued that individual differences were important

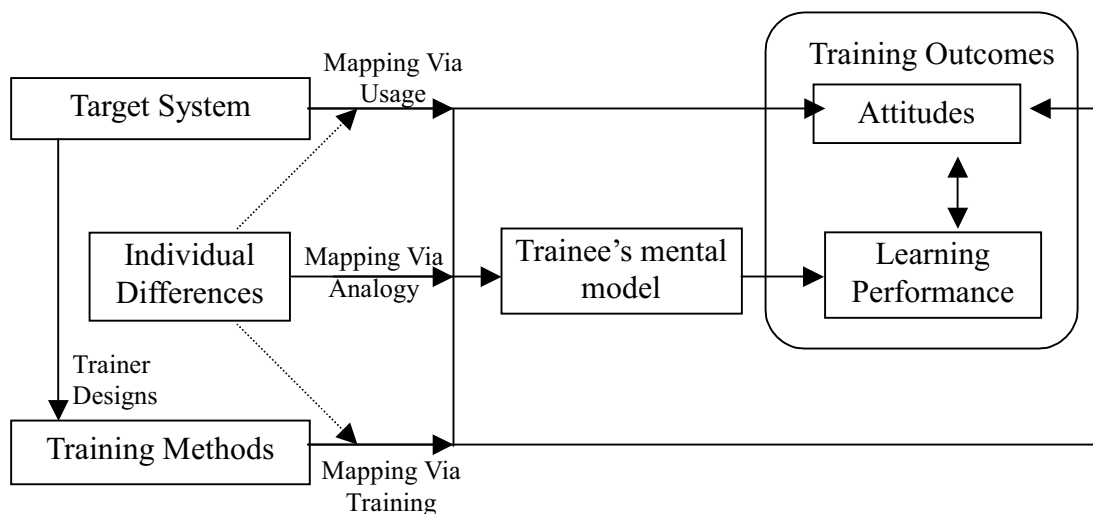


Figure 1. The Research Model for End-user Training

on end-user training (Bostrom, et al, 1988; Davis and Davis, 1990; Harrison and Rainer, 1992). Individual differences would interact with the target system and/or training method to affect training outcomes. And there were two major training outcomes one was the learning performance and the other is the motivation to use it. Learning performance has been measured by several ways such as the efficiency of system use, accuracy of tasks and the ability of problem solving (Stagger and Norcio, 1993).

Bostrom offered a comprehensive research framework on the end-user training processes. However, in this study, we just take individual differences, training method and training outcomes as major constructs. We try to investigate whether or not the training methods and individual differences affect training outcomes. In the same time, we take accuracy of tasks and learning confidence (Chan, et al., 1993) as the measures of training outcomes.

Learning Style means that under the conceptual environment with which learners affect mutually, learners will train a kind of quite stable responsive way. It often includes individual cognitive style, the characteristics it affection and physiology (Keefe, 1988). Learning style also includes uniqueness, stableness and consistence. In a word, learning style is the learning preference in the processes of learning. There are numerous classification methods on learning style. Among them, the Kolb's Learning Style Theory (1976) was the most popular adoption in education circles. In this article, we adopt Kolb's classification by dividing individual's learning style into four types as Accommodator, Diverger, Converger and Assimilator. We describe these four styles below. (Kolb D. A., 1985)

- 1) The accommodative learning style emphasizes concrete experience and active experimentation. The greatest strength of this orientation lies in doing things, in carrying out plans and tasks and getting involved in new experiences. The adaptive emphasis of the orientation is on opportunity seeking, risk taking, and action. This style is called accommodation because it is best suited for those situations where one must adapt oneself to changing immediate circumstances. In situations where the theory or plans do not fit the facts, those with an accommodative style will most likely discard the plan or theory. People with an accommodative orientation tend to solve problems in an intuitive trail-and-error manner, relying heavily on other people for information rather than on their own analytic ability.
- 2) The divergent learning style emphasizing concrete experience and reflective observation. The greatest strength of this orientation lies in imaginative ability and awareness of meaning and values. The primary adaptive ability of divergence is to view concrete situations from many perspectives and to organize many relationships into a meaningful "gestalt." The emphasis in this orientation is on adaptation by observation rather than action. This style is called diverger because a person of this type performs better in situations that call for generation of alternative ideas and implications, such as a "brainstorming" idea session. Those oriented toward divergence are interested in people and tend to be imaginative and feeling-oriented.
- 3) The convergent learning style relies primarily on the dominant learning abilities of abstract conceptualization and active experimentation. The greatest strength of this approach lies in problem solving, decision-making, and the practical application of ideas. We have called this learning style the converger. The person with this style seem to do best in situations like conventional intelligence test, where there is a single correct answer or solution to a question or problem. In this learning style, knowledge is

organized in such a way that through hypothetical-deductive reasoning, it can be focused on specific problems. Liam Hudson's (1966) research on those with this style of learning shows that convergent people are controlled in their expression of emotion. They prefer dealing with technical tasks and problems rather than social and interpersonal issues.

- 4) In assimilation, the dominant learning abilities are abstract conceptualization and reflective observation. The greatest strength of this orientation lies in inductive reasoning and the ability to create theoretical models, in assimilating disparate observations into an integrated explanation (Grochow, 1973). As in convergence, this orientation is less focused on people and more concerned with ideas and abstract concepts. Ideas, however, are judged less in this orientation by their practical value. Here, it is more important that the theory be logically sound and precise.

3. Research Model and Hypotheses

After reviewing the related literatures, we would like to study the effect of learning through two distinct teaching methods, besides we also exam the relation of the learning style and the learning performance. Our research model is showed as below (See Figure 2). The model asserts that the teaching methods and a user's learning style influence the learning performance of a learner simultaneously. We acquire detailed descriptions of these variables below.

3.1 Independent Variable

The

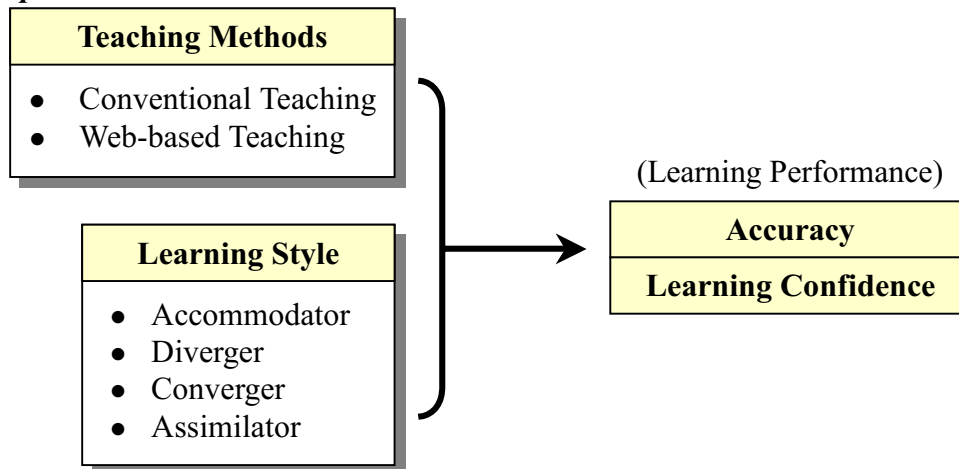


Figure 2. Research Model

Teaching Method

In this study, we investigate the effects of two different teaching methods on the student's learning performance by teaching a computer software package. Two teaching methods we adopted here are conventional teaching and web-based teaching. In the conventional environment, students go to class once a week, the teacher lectures on the class and the student interacts with his/her computer while listening to a lecture. In the web-based learning environment, we first adopted a network learning system called VICAS, which was developed by professor Hong of Nation Taiwan University. Meanwhile, we constructed a software package course on it. The Ministry of Education in Taiwan sponsored the development budget of VICAS system and the professor Hong conducted an experiment on this system by teaching Business Administration for more than three years. At present,

several institutions such as the Library of Tamkang University, Hsinchu Teachers College etc, had used this system for some kind of teaching activities. We use this courseware, design a course on it, and take some modifications of the system. The functions of the system had been separated into two parts. The first part can be called as the course administration area, where the teacher gives the course and maintains the contents if necessary. The second part can be named as the virtual classroom, where the student attends the class and performs all learning activities in this section. Figure 3 depicts the functions of the VICAS network learning system. By using the browser, the student can log in this web-based system with his/her account and password (At first time to login, the student were asked to register a personal account.). The system would automatically record each student's learning activities during this login session. On the other hand, the teacher can connect the system with administrator's account, and perform some activities such as composing materials, managing the course, replying students' questions and so on.

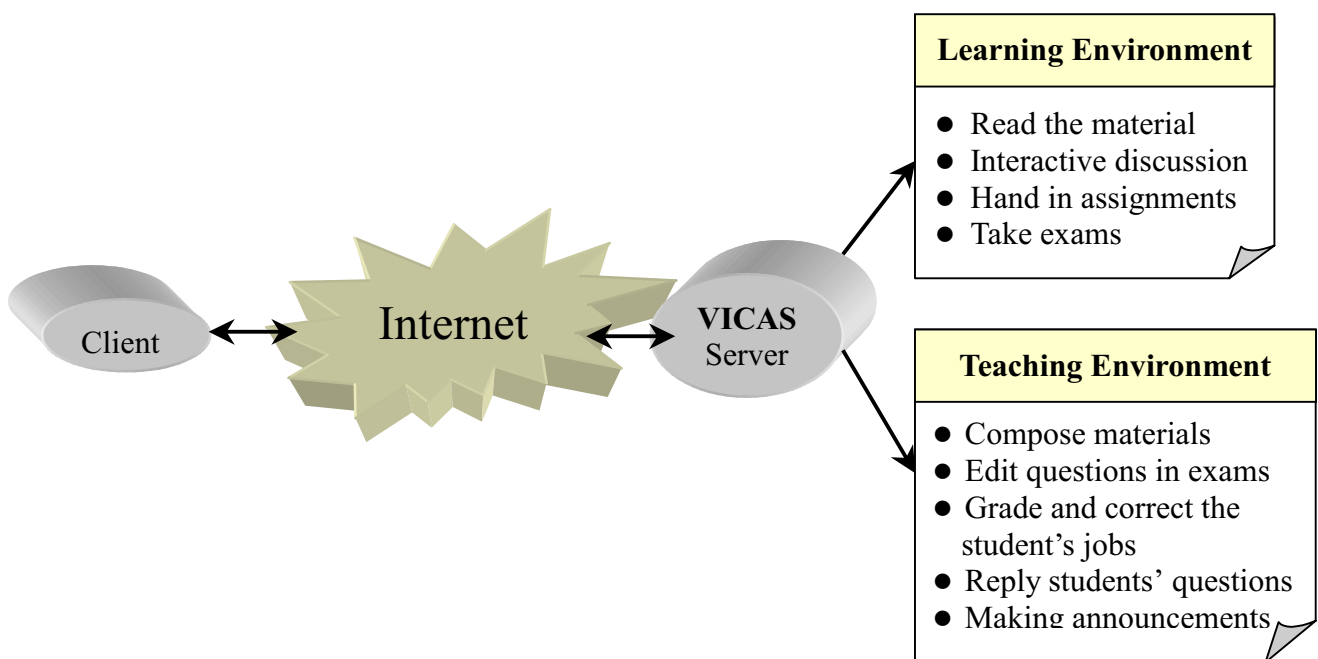


Figure 3. The Function on Network Learning System

Learning Style

We adopt the Kolb's learning style theory, and divide the learning style into four roles: Accommodator, Diverger, Converger and Assimilator. The instrument we use to classify the learning style of each subject is the Learning-Style Inventory developed by Kolb (1985). The questionnaire has been translated and used by many researchers, and the validity and reliability had been verified.

3.2 Dependent Variable

Accuracy and Learning Confidence

We evaluate the learning performance by the accuracy of executing a task and the student's learning confidence. After finish the training courses, we will assign a related task to evaluate the learning performance of accuracy. Students attend the exam together in computer rooms. Each student had the same exam paper and was asked to use Microsoft Word 2000 to accomplish his job. We concocted the exam paper on the basis of the materials that composed

before class. It contains the all educational objectives and major contents, and to tally with the needs of content validity basically.

Chan, et al. (1993), used accuracy, the time taken and the subject's confidence as the measurements of students' learning performance in an experiment on User-Database Interface. In our study, we used learning confidence variable to evaluate the feeling of the progression of each subject. The whole learning materials can be divided into six units and a four Likert-scale value is measured in each unit ranging from 0 (no difference) to 3 (significant effect on progressing).

3.3 Research Hypotheses

Based on the research framework on Figure 2, four hypotheses can be identified and addressed as follows.

H1: There will be no difference in the accuracy of the task from subjects in the conventional teaching and the web-based teaching groups.

H2: There will be no difference in the learning confidence of subjects in the conventional teaching and the web-based teaching groups.

H3: Students with different learning style will make no difference in accuracy of executing the task.

Hypothesis 3 can be further divided into the following two sub-hypotheses.

H3-1: Under the conventional teaching environment, there will be no significant difference in accuracy of executing task from subjects.

H3-2: Under the web-based teaching environment, there will be no significant difference in accuracy of executing task from subjects

H4: Students with different learning style will make no difference in the learning confidence

The following two sub-hypotheses can be derived from the Hypothesis 4.

H4-1: Under the conventional teaching environment, there will be no significant difference in the learning confidence of students with different learning style.

H4-2: Under the web-based teaching environment, there will be no significant difference in the learning confidence of students with different learning style.

4. Research Design

The research methodology was a field experiment to take subjects from two juniors' class of Business Administration in the local university.

4.1 Subjects

We chose 161 students who major in Business Administration from two classes as subjects. They all had some entry-level knowledge about computer and communication network for they had taken the basic computer introduction course when they were freshmen. We randomly selected one class as the experimental group to teach them in web-based environment. Meanwhile, We treated the other class as the comparative group to teach them by conventional method. The subjects of both classes took the one-semester course of Data Processing, so they have to attend this class every week. In the same time, the students didn't be informed that they had participated in an experiment.

The subjects were all juniors and came from the same institute; they had similar learning

background. The demographic difference between these two groups is very small. Since some advanced usage of Microsoft Word were the major focus of the learning target, we designed a questionnaire to inquire the practiced experience of this word processing software and found that the average experiences of both groups were not significant by an independent sample T-test. We found that most of subjects got the abilities of file processing as well as simple word editing. However, most of them were not familiar with sophisticated functions such as paragraph adjusting, graph editing, position point setting and so on. We omitted 33 subjects from our sample in the data analysis phase for some of these subjects didn't complete some questionnaires or the final exam. Table 1 shows the demographic statistics of these 128 valid subjects.

Table 1. Demographic Statistics

Character of participants	Comparison Group	Experienced Group	Total
Numbers of participants :	62	66	128
Gender :			
Male	29	28	57
Female	33	38	71
Age :			
Under 19	0	0	0
19~21	54	55	109
22~24	7	11	18
25~27	1	0	1
Above 27	0	0	0
Learning Style :			
Accommodator	17	19	36
Diverger	23	16	39
Converger	3	6	9
Assimilator	19	25	44

4.2 Experimental Procedure

The experimental time lasted for ten weeks. Figure 4 shows the schedule of this experiment. At first week, the subjects were asked to fill in the Learning Style Inventory and the questionnaires of computer background as well as the practiced experience of Microsoft Word. At the same time, the instructor gave an introduction of the class, guided the students to use the network learning system, and helped them to register on the system in the web-based group. From the second to the ninth week, the experimental group attended the course on the web using the network learning system. They participated in discussions, handed in assignments on the web, and didn't go to class actually. On the other hand, the student of the comparative group should go to class and take a lecture from the instructor once a week. (The detail activities of the course will describe in the next section)

After having finished the training courses, all subjects took an exam simultaneously in three computer classrooms with two assistants for each room. Before delivering the exam papers and disks, the assistant spent five minutes to brief the exam's directions. The students have

their seats by the ascending of their identification number and gave sixty minutes to finish the jobs by saving their files into the disk. When the time was up, assistants in each room gathered all of the disks, and the student dismissed.

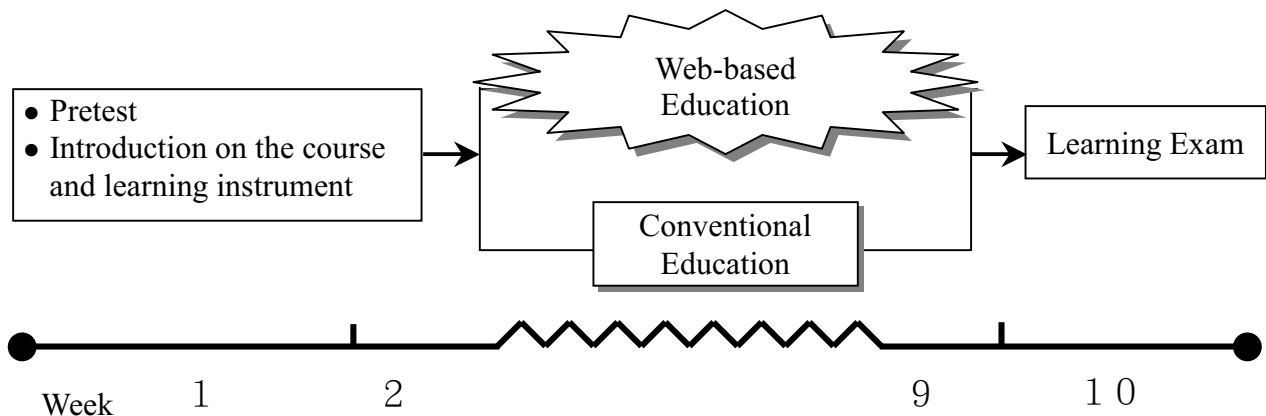


Figure 4. Experimental Procedure

4.3 Educational *Portfolio* / Learning Activities

The target system in our study is Microsoft Word 2000. The two teaching methods we adopted are conventional teaching and web-based teaching. Students in the former group should go to class once a week and the instructor would giving a lecture on the class. The Web-based teaching carries out all of the teaching activities on the network leaning system—VICAS, which constructed on the WWW. Figure 5 depicts the network-learning environment. The students login the system to read the materials in any time, and not go to class actually. All learning activities such as handing in assignments, participating in a discussion and so on were executed on the web.

On the aspect of composing the instructive materials, we first gathered some professors' teaching plans and a few reference books of this course to create a draft. Then we revised the original version several times to discuss with these professors and translated the final version into the HTML format. In Figure 5, we can see all the activities on this web-based system. Particularly, there is a special task called 「knack」 which will ask students to post the tricks, tips and supplements that were found during their practice. The instructor will score the grades of each knack and give some recommendations. The students can access all knacks from all classmates and take some notes by themselves. Besides, the instructor can provide the dynamic tuition files that screening all the operations for executing some tasks. The student can look on the files repeatedly and download them to read off-line.

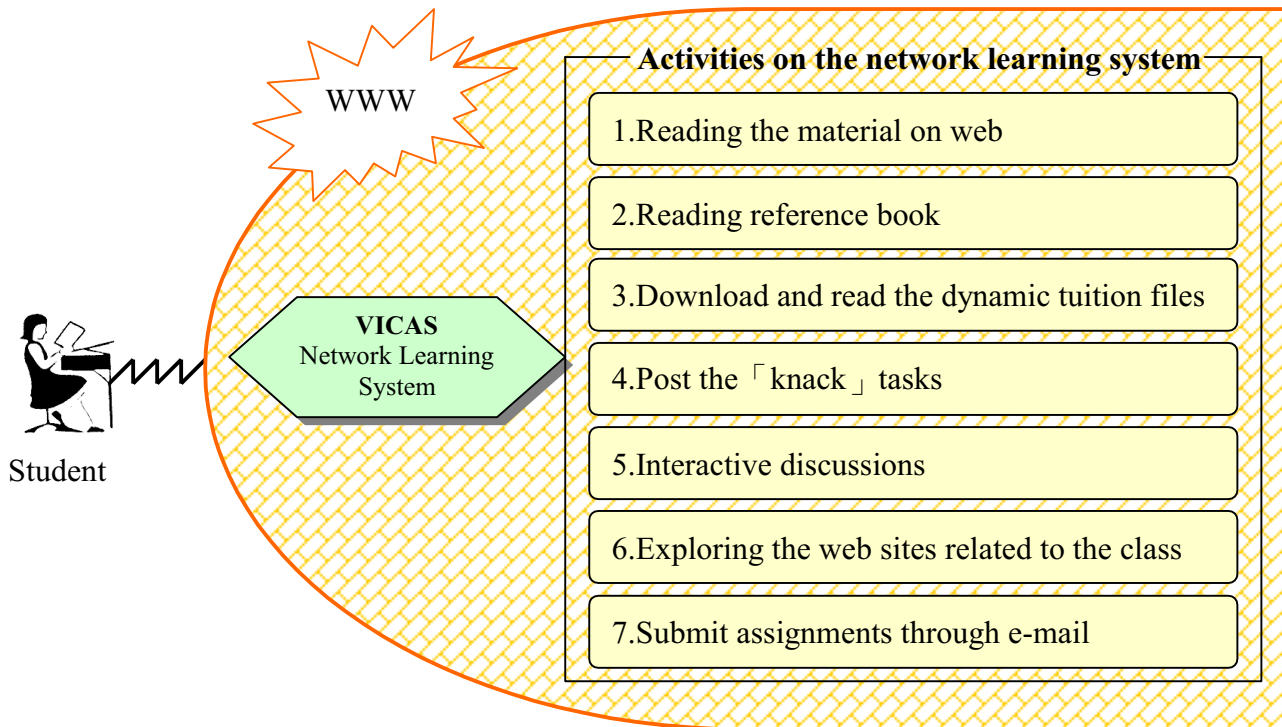


Figure 5. The Network Learning Environment

5. Data Analysis and Hypothesis Testing

We used one-way ANOVA to verify the hypotheses in the section 3. Table 2 summarizes the number of samples and the means for each dependent variable. Table 3 outlines the ANOVA test data of this experimental result.

Table 2. Means and the Number of Samples for Teaching Methods and Learning Styles

Teaching Methods:	Conventional Teaching				Web-based Teaching				Overall					
	A	D	C	S	A	D	C	S	Con.	Web	A	D	C	S
N of Samples	17	23	3	19	19	16	6	25	62	66	36	39	9	44
Accuracy	63.4	61.0	82.7	61.8	65.8	64.1	63.2	62.9	62.9	64.1	64.6	62.3	69.7	62.4
Learning Confidence	7.9	7.9	8.7	9.3	8.7	9.3	9.5	9.4	8.4	9.2	8.3	8.5	9.2	9.3

A: Accommodator, D: Diverger, C: Converger, S: Assimilator

Hypothesis H1 tried to verify whether or not the different teaching methods would affect on accuracy performance of students. The experiment result showed that the performance difference on accuracy between web-based group and conventional group was not significant ($p=0.645$). Dues to the long experiment in this study the students that did not attend the class or did not go on the web for learning would affect the learning performance. Thus we sifted

out the student who had attended the course only once in the conventional group and the

Table 3. ANOVA Results for Learning Outcomes

Accuracy	F	P
Teaching Method	0.214	0.645
Learning Style	0.858	0.465
Learning Style under Conventional teaching	2.703	0.054 *
Learning Style under Web-based teaching	0.140	0.936
Learning Confidence	F	P
Teaching Method	2.800	0.097 *
Learning Style	1.000	0.395
Learning Style under Conventional teaching	0.817	0.490
Learning Style under Web-based teaching	0.285	0.836

* $p < .10$

students who visit the web site less than five times; then we use the rest subjects' data to run the analysis. (There are 58 samples in comparison group, 57 in experienced group after sifting). Under this constraint, there was still no significant difference on the performance between these two groups ($p=0.405$).

In hypothesis H2, we tried to test the different learning confidence of two teaching methods and found that the difference between them was significant at level 0.1 ($p=0.097$). This figure means that the web-based subjects had stronger learning confidence than their counterparts in this experiment. The testing results of hypothesis H3 ($p=0.465$) and H3-2 ($p=0.936$) could not be rejected. But H3-1 was rejected under significant level at 0.1 ($p=0.054$), it showed the difference between the learning styles on accuracy under the conventional teaching. Hypothesis related to the effects of learning style on learning confidence (H4, H4-1, H4-2) could not be rejected. The testing results were showed in Table 3, Table 4.

6. Conclusion and Discussion

The study investigates the learning effect of software package training between the web-based learning and the conventional learning. We conducted a field experiment with 161 subjects in the University to get some experimental data for comparison. The results indicated that the subjects' learning performance in terms of accuracy was no difference under the two learning conditions. However, the learning confidence of the students with web-based platform was significant higher than the confidence of conventional one. The statistical results seem to be reasonable according to our observations. In the conventional learning environment, the students can carry on the operations step by step following the instructor's demonstrations. And because of their learning in the classroom regularly, their progressions are under supervising. But it causes the students who are slow in learning can't catch up the instructor's tempo to give up the course frequently. Moreover, though the students have their own computers in the classroom, a few students seated in back of the classroom with a bad vision do not concentrate their attentions on the class to give up learning finally. On the contrast, the students who taking class through the network learning system could control the learning tempo by themselves. They can attend a class via WWW in their best learning conditions. The creepy-learning students can read the materials over and over again until they totally familiar with the related operations on the course. Besides, the rich resources in the

web are helpful for learning efficiently and monitoring automatically. According to the

Table 4. Summary of Hypothesis Tests

Hypotheses	P-Value	Significance
H1: Differences on accuracy of Teaching methods	0.645	
H2: Differences on learning confidence of Teaching methods	0.097	*
H3: Differences on accuracy of Learning styles	0.465	
H3-1: Differences on accuracy of Learning styles under the conventional environment	0.054	*
H3-2: Differences on accuracy of Learning styles under the web-based environment	0.936	
H4: Differences on learning confidence of Learning styles	0.395	
H4-1: Differences on learning confidence of Learning styles under the conventional environment	0.490	
H4-2: Differences on learning confidence of Learning styles under the web-based environment	0.836	

* : Significant level at 0.1

system logs, the instructor can detect the students seldom online and notify them by the e-mail. On the other hand, study attitudes, individual styles and learning environment for the subjects seem to be the major factors affecting the difference of learning confidence.

In this experiment, we found that different learning styles would influence the student's performance on accuracy and convergers had the best performance in conventional environment. The result was the same as Sein and Robey's (1991). But in the web-based learning environment, it had no significant differences among the four learning styles. It may be the reason that the student in web-based learning environment could choose the materials and arrange their learning schedules that suitable for them. This kind of learning method accommodate flexible learning tempo for different learning style students, and reduce the different performance made by them.

On the other hand, the subjects of the web-based education got similar score on performance and higher score on learning confidence than the counterparts of the conventional environment.

In the future research, more efforts on implementing web-based learning could be performed, it will be helpful to implement the web-based learning when the function of the management on rate of progress is improved and software package on-line exam is added. The adoption of the new technology on education would be a grand benefit for numerous people, such as the students who living far away from school or handicapped students. The organizations could consider the new technology on their training programs, too.

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