

TEACHING “ORGANIZATION OF INFORMATION” THROUGH THE WEB

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Abstract: In order to prepare continuing professional education (CPE) courses for web-based instruction (WBI), it is essential to know the effects of learning styles and modes of instruction on student achievement. This study reports implications and recommendations for using and designing WBI that may be transferred to preparing CPE courses.

At Suranaree University of Technology (SUT) in Thailand, the instructional unit, Organization of Information, has been taught to first year students as one component of the course “Logical Thinking,” a general education course. The objective of this course is to instruct students in how to use library systems and information technology for academic purposes. Nearly 1,300 first year students enter each year, but only one faculty member available to provide the teaching for this number of students. Therefore, the University plans to offer this course, which is presently being provided in a face-to-face classroom format, via a distance education system for the Library and Information Science (LIS) program.¹

The emergence of the Web has provided a dramatic stimulus to distance education institutions to move more to an online learning environment. SUT is no exception to this. The University project, “Borderless Education,” is responsible for offering courses through the Web. The system is being implemented by creating various courses in this format. The “Logical Thinking” course and courses in LIS are also included in the plan. Developing effective web-based instruction (WBI) that meets the students’ interaction needs is the goal.

This study investigates the effect of interactions between learning styles and interaction modes of participation on achievements of Thai students involved in WBI for the course, “Organization of Information.” Information pertaining to preferred interaction modes of WBI that fit students’ learning styles will aid in the development of an effective WBI program that meets the students’ interaction needs. The following questions are the basis for the detailed investigation:

1. What are the differences in the achievement of students whose learning styles are classified as Convergents, Divergers, Accommodators, and Assimilators?
2. What are the differences between the achievement of students who receive WBI with the social and instructional interaction modes and the achievement of those who receive WBI with the instruction-only interaction mode?
3. What is the nature of the effect of both the social and instructional interaction modes and the instruction-only interaction mode in WBI on achievement for the four types of learning styles?

Based on the research questions, the following null hypotheses are made:

1. There will be no significant difference in achievement for students who are classified as Convergers, Divergers, Accommodators, and Assimilators.
2. There will be no significant difference in achievement for students who receive WBI with the social and instructional interaction modes and those who receive WBI with the instruction-only interaction mode.
3. The interaction between learning style and type of WBI will have no effect on achievement.

The assumptions of this study are as follows:

1. There will be students in Thailand who fall into the four categories of the Learning Style Inventory defined by Kolb as Converger, Diverger, Accommodator, and Assimilator.²
2. Subjects in the different learning styles will not have significant differences in degree of previous knowledge related to Organization of Information because none of them have taken this course before.

The limitations of this study are as follows:

1. This study focused only on Organization of Information as an example of how to develop a WBI for Library and Information Science Distance Education. Therefore, the methods used were limited to this particular course only.
2. The sample was selected from only one university, Suranaree University of Technology. The results of this study may not be able to be generalized to other populations outside of Thailand.
3. The experiment was designed for the Web-based teaching setting. Therefore, the result cannot be compared to a traditional classroom setting.

The results of this study should provide useful information for SUT not only in developing this course, but also other courses. Results should apply to open universities in Thailand and to other educational institutions and continuing professional education (CPE) providers planning to employ WBI as a distance learning delivery system.

LITERATURE REVIEW

The development of distance education benefited from the development of telecommunication and information technology starting from printed material to WBI. WBI is viewed as an innovative approach for delivering instruction to students from a distance. Literature suggests numerous advantages of WBI as a distance education modality,³ especially enhanced social interactions, since these are considered by many educators to be weak in the conventional educational modality. Synchronous and asynchronous modes of WBI such as chat room, Web bulletin board, and email open a communication channel allowing teacher and students to interact readily with each other.⁴ Research also suggests that students who have a positive attitude learn well from WBI.⁵ The degree of interaction between instructor and students and among students positively affects the success of their study in distance learning.⁶ This present study focuses on how a participatory interaction mode of students involved in WBI will effect their achievement.

Studies of learning style indicate that instruction designed to fit students' learning styles can improve their academic performance.⁷ Learning style while defined differently by different researchers, can be organized into three broad categories: instructional preference; information processing preference and personality related preference. Defining learning styles as one's preferred methods for perceiving and transferring information,⁸ Kolb's learning style model is based on the experiential learning theory and is categorized as information processing preference. Kolb's Learning Style Inventory (LSI) has been developed to determine an individual's learning style and categorizes these as being of four types: Converger, Diverger, Accommodator, and Assimilator.⁹ This study focuses on how the different learning styles of students identified by Kolb effect their achievement when participating in WBI with two different modes of interaction.

METHODOLOGY

This research was designed to determine the effect of learning styles and participatory interaction modes on achievement of first year students involved in WBI in one course at SUT in Thailand. Based on factorial design, two or more independent variables were studied at the same time to determine their independent and interactive effects on the dependent variable.¹⁰ Four instruments were used to identify subjects and to collect data. The main effect and interaction effect were used to determine the effect of learning styles and participatory interaction modes on achievement. This study was conducted in the following stages addressed below:

1. Two types of WBI were developed, one with social and instructional interaction modes and another with instruction-only interaction mode. They were used as instructional tools to provide instruction in the Organization of Information.
2. A pre-test was developed to assess the students' prior knowledge of the course.
3. A post-test was developed to assess students' achievement.
4. The LSI Test developed by Kolb was translated into the Thai language.
5. A pilot study was done on the three instruments: WBIs, pre-test, and post-test.
6. Learning styles of students who were used as subjects in the experiment were inventoried using the test developed by Kolb. Students were categorized on specific learning styles from among the four styles: Converger, Diverger, Accommodator, and Assimilator.
7. A pre-test collected data about prior knowledge of course content.
8. The experiment was conducted.
9. A post-test was administered to collect data about students' achievement.
10. The effects of learning styles and participatory mode of interactions in WBI on the students' achievement were determined.

Independent variables considered in this study included the following:

1. Learning Styles: Converger, Diverger, Accommodator, and Assimilator.
2. WBI: with social and instructional interaction modes, and with instruction-only interaction mode.

The dependent variable for this study was the achievement of the students. The subjects used in this study were drawn from SUT first year students enrolled in a Logical Thinking class in the 1999 academic year. The total population was 1,212. Simple random sampling was used to

obtain 400 participants. This assumes that the discipline in which a student is majoring is not an important concern.

Kolb's LSI test was administered to 400 participants in order to assess each student's type of learning style. Simple random sampling was used again to obtain 50 subjects for each type of learning style and to divide each group of 50 into two groups. Each of the types of learning style had two groups, one treated with social and instructional interaction modes and the other treated with instruction-only interaction modes. The design is shown in Table 1.

Table 1: The Design of Subject Use

Learning Styles	Treatment 1 WBI with Social and Instructional Interaction Modes (B 1)	Treatment 2 WBI with Instruction- only Interaction Mode (B 2)
Diverger (A1)	A1, B1	A1, B2
Converger (A2)	A2, B1	A2, B2
Accommodator (A3)	A3, B1	A3, B2
Assimilator (A4)	A4, B1	A4, B2

Three of the four instruments used in this research were developed by the researcher: WBI on the course, a pre-test for testing prior knowledge of content, and a post-test to assess students' achievement. Although a 1987 translation of Kolb's LSI into Thai already existed, this researcher was not satisfied with the understandability of that version. Therefore, the Kolb Learning Style Inventory was again translated into Thai.

The purpose of the WBI was to serve as a means of instruction for students who take a Logical Thinking class at SUT. The design team consisted of the instructor (researcher), a subject matter expert (Dr. Arlene G. Taylor), and two Web designers (Mr. Marut Buranarach, a Ph.D student in Information Science, and Mr. Gwyn Chatranon, a Ph.D. student in Telecommunications).

The contents of WBI comprise three modules of the unit, "Organization of Information," which is considered in the cognitive domain of learning. The objectives of these three modules are to provide students with knowledge and comprehension on the topic as well as to enable them to apply the principles and theories in actual situations. Detailed course objectives were identified using the Instructional System Design (ISD) model based upon the work of Seels and Glasgow.¹¹ The ISD model is a system approach to the design of instruction comprising five phases: analyzing tasks; writing objectives; assessing learning; selecting and developing delivery systems; and evaluating ISD decisions. This system approach offers the most prescriptive guidelines available for classifying instructional objectives and preparing evaluation for them.

Two types of the WBI were designed: one with the social and instructional interaction modes and another with the instruction-only interaction mode. The WBI with social and instructional interaction modes comprises features of email, email distribution lists, chat-groups, bulletin board, hyperlink, FAQs, and exercises. The WBI with instruction-only interaction mode comprises features of hyperlink, FAQs, exercises, and email with instructor. These two types of WBI were used as treatments for the four types of learning styles. Different passwords for accessing the different types of WBI were assigned to the two groups of participants with different treatments.

Pre-testing is used to obtain an empirical demonstration of whether the treatment condition has succeeded in producing a change in the research participants.¹² In this study, a pre-test comprised of 20 matching items (40 points) which was based on learning objectives stated in the course outline was used to assess the prior knowledge of students of the course content before the treatment.

A post-test is used by teachers to gather information about a student's learning. It serves as an instrument to assess whether the instruction has achieved its learning objectives or whether students have learned at the level stated in the learning objectives. The post-test to assess achievement of the students involved in this WBI on organization of information was the same as the pre-test.

The Learning Styles Inventory, a twelve-item questionnaire developed by Kolb, was administered to each student. Each item has four possible answers, and the respondents are asked to rank order four possible answers. Each answer corresponds to one learning mode: Concrete Experience (CE: learning from feeling), Reflective Observation (RO: learning by watching and listening), Abstract Conceptualization (AC: learning by thinking), or Active Experimentation (AE: learning by doing). This forced-choice ranking produces a score for each of these learning orientations ranging from 12 to 48.

Combining the scores of the four learning modes and following the formulas—Abstract Conceptualization minus Concrete Experience [(AC)-(CE)] and Active Experimentation minus Reflective Observation [(AE)-(RO)] results in two combination scores. By plotting the combination scores on a grid and identifying the quadrant where the two scores intersect, one can determine a specific learning style from among the four styles: Converger, Diverger, Accommodator and Assimilator.

The survey form was developed to discover problems and attitudes of participants who were asked to complete the survey form after the treatment on August 13, 1999. The survey form comprises three parts: opinions about the content and format of WBI; technical problems on accessing the WBI; and attitude to the use of WBI. The information from these survey forms was used for a supplementary analysis.

A pilot study was conducted with a small number of participants to indicate whether the independent variable manipulation produces the intended effect.¹³ Three instruments, two versions of WBI, pre-test, and post-test, were tested from May 11-19, 1999. Participants who volunteered in the pilot test were 10 Thai-speaking undergraduate students at Carnegie Mellon University. Results from the pilot test were used as a formative evaluation to refine the instruments. Participants in the pilot study expressed their concern about some of the technical terms used in the content. Most participants were familiar with the English terminology so they were uncomfortable with the Thai translation version. In order to solve this problem, English technical terms were inserted in parentheses appropriately in each unit of the content. In addition, some screens were revised and typos were corrected.

Data collection began in May 1999. A list of 1,212 students was obtained from the Center for Educational Services, SUT via World Wide Web <http://sut4.sut.ac.th:8001/cgi-win/ces/major_id_query.exe/ces/>. Simple random sampling was used to enlist the required 400 participants.

The Thai language version of Kolb's LSI test with instruction, and a demographic data sheet were sent as an attached file with email to the director of the Center for Library Resources and Educational Media, SUT to make 400 copies. The LSI was administered to 400 participants on May 22, 1999 to determine their learning style. The participants completed the demographic

data inventory and the Kolb's LSI test. This stage of data collection was assisted by the director of the SUT central library. The LSI tests were analyzed and the participant's learning styles were identified by the researcher in June 1999. The number of participants that fell into each of the four types of learning styles is shown in Table 2. Simple random sampling was administered to the 400 participants to obtain 50 subjects for each type of learning style, Converger, Diverger, Accommodator, and Assimilator, or 200 subjects totally, and to divide each group of 50 into two groups.

Table 2: Participants that Fall into the Four Types of Learning Styles (n=400)

Learning Styles	Number
Converger	119
Diverger	68
Accommodator	55
Assimilator	158
Total	400

The pre-test was administered to 200 subjects on July 16, 1999 to assess their prior knowledge of organization of information. The four types of subjects were each treated with the two types of WBI, one of each type with social and instructional interaction modes and the other of each type with the instruction-only interaction mode. The treatment was taken three hours a week for three weeks during July 23 - August 6, 1999. Subjects were given a log sheet in which they indicated the time and duration of use of WBI. The group with the social and instructional WBI had chat-group sessions on every Thursday from 10.00 a.m.-6.00 p.m. A post-test was administered on August 19, 1999 as a part of the final examination of the Logical Thinking course. The pre-test and post-test were administered in a lecture hall of SUT. The achievement scores from the post-test were used to analyze and determine the effect of learning styles and participatory mode of interaction on the students' achievement.

The Statistical Package for Social Sciences (SPSS) was used to analyze the collected data. The two-way analysis of variance (ANOVA), a statistical test that is applied to data collected from a factorial design in which two or more independent variables are studied simultaneously to determine their independent and interactive effects on the dependent variable,¹⁴ was used to test hypotheses at the .05 level of significance. The focus of the analysis was to examine if there is a significant difference between learning styles and participatory interaction modes on achievement. Information pertaining to opinion, attitude, and comment of participants in the survey forms were analyzed qualitatively.

RESEARCH FINDINGS

Since one student dropped out of the course during the experiment, 199 students were used as subjects in the final analysis. Table 3 shows the number of subjects grouped by types of learning style and treatment. Each learning style in each treatment comprised 25 subjects except for the Diverger-type of learning style in treatment two, which comprised 24 subjects.

Table 3: Learning Styles of Subjects (n=199)

Learning Style	Treatment 1	Treatment 2	Total
Converger	25	25	50
Diverger	25	24	49
Accommodator	25	25	50
Assimilator	25	25	50
Total	100	99	199

Table 4 reports subject characteristics. As shown, 121 males (60.8%) and 78 females (39.2%) participated. The majority of subjects majored in engineering (70.9%). All subjects had at least one month of computer experience. The distribution of computer experience was skewed. More than half the subjects (62.3%) had more than two years of computer experience. Almost nineteen percent (18.6%) had one to two years' experience with computers, while 14.1 percent had between six months to one year of experience. Only five percent (5%) had less than six months of experience. In terms of WWW experience, most participants had from one to six months or from six months to one year experience with the WWW (37.2% and 32.7% respectively). The numbers of participants who had the most experience (more than two years) with the WWW was equal to those who had no experience with the WWW (6.0%).

Table 4: Subject Characteristics

Subject Characteristics	Frequency	Percent
1. Gender		
Male	121	60.8
Female	78	39.2
2. Major		
Engineering	141	70.9
Information Technology	45	22.6
Agricultural Technology	12	6.0
Health Science	1	0.5
3. Computer Experience		
1-6 months	10	5.0
6 months-1 year	28	14.1
1-2 years	37	18.6
More than 2 years	124	62.3
4. WWW Experience		
No experience	12	6.0
1-6 months	74	37.2
6 months-1 year	65	32.7
1-2 years	36	18.1

More than 2 years	12	6.0
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Not all subjects in treatment one used the bulletin board and chat room. Table 5 shows the frequency distribution of the use of bulletin board and chat room. Most subjects (73) used the bulletin board three times while a few of them (7) did not use the bulletin board at all. Regarding the chat room, most subjects (36) used the chat room only one time whereas a few (10) used the chat room three times (i.e., the most use by anyone). The number of subjects using the chat room only once (36) is slightly higher than those who used the chat room two times (30). Twenty-four subjects did not use the chat room at all.

Table 5: Frequency Distribution of the Use of Bulletin Board and Chat Room in Treatment 1 (n=100)

Use of BB and Chat Room	Frequency	Percent
Bulletin Board (BB)		
None	7	7.0
1 time	6	6.0
2 times	14	14.0
3 times	73	73.0
Total	100	100.0
Chat Room		
None	24	24.0
1 time	36	36.0
2 times	30	30.0
3 times	10	10.0
Total	100	100.0

Descriptive statistics were computed to determine the relationship between the use of the bulletin board and the chat room. As shown in Table 6, ten subjects (10.0%) used both the bulletin board and the chat room three times. The highest percent of subjects (25%) used bulletin board three times and the chat room once, while nearly as many (24%) used the chat room two times and the bulletin board three times. Only four students (4%) did not use either.

Table 6: Relationship Between the Use of Bulletin Board and Chat Room (n=100)

Bulletin Board	Chat Room									
	None		1 Time		2 Times		3 Times		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
None	4	4.0	2	2.0	1	1.0	-	-	7	7.0
1 Times	3	3.0	3	3.0	-	-	-	-	6	6.0
2 Times	3	3.0	6	6.0	5	5.0	-	-	14	14.0
3 Times	14	14.0	25	25.0	24	24.0	10	10.0	73	73.0
Total	24	24.0	36	36.0	30	30.0	10	10.0	100	100.0

To test the three null hypotheses, a two-way ANOVA was conducted. This analysis was carried out both with the entire sample (n=199) and after removal of the subjects in treatment one who did not visit the bulletin board or the chat room at least once (n=195). Table 7 and Table 8 present the results of the two-way ANOVA on the post-test when n=199 and n=195 respectively. Meanings of these results are explained in the sections that follow.

Table 7: Results of Two-way ANOVA on Post-test (n=199)

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Treatment	18.232	1	18.232	1.380	.242
Learning Style(LS)	105.177	3	35.059	2.653	.050
Treatment*LS	42.192	3	14.064	1.064	.365
Error	2524.198	191	13.216		

Table 8: Results of Two-way ANOVA on Post-test (n=195)

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Treatment	16.833	1	16.833	1.259	.263
Learning Style(LS)	108.105	3	36.035	2.696	.047
Treatment*LS	45.573	3	15.191	1.136	.336
Error	2499.617	187	13.367		

A probability value of 0.050 was obtained by analysis using two-way ANOVA (Table 7). This result can be interpreted as meaning that there is a significant difference on the post-test among the learning styles when n=199. A statistically significant difference (Sig=0.047) was also obtained with n=195 subjects, as shown in Table 8. Therefore, the subject's classification into four types of learning styles was related to their achievement scores.

In order to test which learning styles were significantly different from each other, a multiple comparison of post-test results was done among the four types of learning styles. The results of the analysis showed that there is a significant difference between the Converger and Diverger learning styles, and is no difference between any other two learning styles.

Analysis by two-way ANOVA (Tables 7 and 8) resulted in non-significant differences in achievement by students who received treatment one and treatment two (i.e., statistical level of significance of 0.242 when n=199 and statistical level of significance of 0.263 when n=195). Therefore, there was no difference in achievement for students who received WBI with social and instructional interaction modes and those who received WBI with the instruction-only interaction mode. Results of the analysis by two-way ANOVA also show that there was no statistically significant difference in treatment and learning style as shown by the levels of significance of 0.365 (n=199) and 0.336 (n=195) respectively.

The primary analysis to test the three null hypotheses was based only on post-test results and did not directly investigate the question of whether the difference between pre-test and post-test means was significant. To accomplish this aim, a paired-samples t-test was conducted to compare pre-test and post-test means. Tables 9 and 10 display the results for n=199 and for

n=195, respectively. As shown in Tables 9 and 10, there was a significant improvement from pre-test to post-test for all students. This means that all students learned from WBI.

Table 9: Results of Paired Samples t-test (n=199)

	Mean	Std. Deviation	t	Sig.
Pre-test	22.10	3.18	25.992	.000
Post-test	29.58	3.69		

Table 10: Results of Paired Samples t-test (n=195)

	Mean	Std. Deviation	t	Sig.
Pre-test	22.11	3.20	25.479	.000
Post-test	29.57	3.71		

Based on the information in the survey forms, the students' opinions concerning the content of WBI are that it is concise, easy to understand and interesting. However, some of them suggested that there should be some images or more examples in order to make some parts of the lessons more understandable. Regarding format, majority felt that the font is easy to read, the symbols are understandable, and the attractive color stimulated them to read. However, all respondents complained about the technical problems with the server, which was frequently down, the insufficient number of computers and the lack of good service from staff of the computer laboratories.

Over all, it was apparent that most students liked to study the course via WBI. According to them, studying on the Web corresponds to one objective of the course that encourages students to use information technology to seek information for academic purposes. This method made them feel more comfortable about asking questions concerning the lesson and other matters compared to when they attend a class in a big lecture hall. This agrees with the finding of a study by Tyan, which found that most Taiwanese students felt more comfortable in expressing their opinions on a computer bulletin board than in a traditional classroom and felt associated with the instructor even though there was no face-to-face interaction.¹⁵ A further opinion expressed was that WBI made students have more self-discipline in studying. In addition, they felt there was the additional benefit of learning more about the Internet and developing their computer skills. Finally, they recommended that the University provide this lesson on the Web to new students, but they did not agree that this should apply to all other courses.

DISCUSSION AND RECOMMENDATIONS

The three null hypotheses were tested for significance at the 0.05 level of confidence.

Ho₁: There will be no significant difference in achievement for students who are classified as Convergents, Divergers, Accommodators, and Assimilators.

Data analysis indicated that the null hypothesis 1 is rejected because there is a significant difference among learning styles (Sig.=0.050 when n=199 and Sig.=0.047 when n=195). That is, there are differences in achievement for the different learning styles. However, the data from

multiple comparison among the four types of learning styles on the post-test showed that the significant difference existed between Converger and Diverger only. There was no difference between any other two learning styles. Thus, Divergers performed significantly better on the post-test than did Convergents.

This finding is consistent with previous research indicating that learning style has an effect on achievement. Oakland & Horton, and Ester found that achievement is improved among students who receive instruction that utilizes teaching strategies that matched their learning styles.¹⁶ Carrier found that there is a relationship between differences in learning styles and preferences for type, frequency, and intensity of instructional feedback.¹⁷ However, these three studies did not use Kolb's LSI. For studies that used Kolb's LSI, the finding of the present study is consistent with findings of a study by McNeal et.al., Bohlen and Ferratt, and Cordell.¹⁸ McNeal, et. al. found significant differences in achievement for different types of learning style for a diploma program. Convergents obtained the highest over-all score in all three instructional groups: agree, disagree, and control. Bohlen and Ferratt found computer-based training is more effective than the lecture method for all types, except Assimilators. Finally, Cordell found that the Converger and Accommodator performed better with the linear computer-based instruction (CBI) whereas the Diverger and Assimilator performed better with the branching CBI.

Ho₂: There will be no significant difference in achievement for students who receive WBI with social and instructional interaction modes and those who receive WBI with instruction-only interaction mode.

The null hypothesis 2 is accepted since there was no significant difference between the two treatments (Sig.=0.242 when n=199 and Sig.=0.263 when n=195). This means that there was no difference in achievement for students who received WBI with both social and instructional interaction modes and those who received WBI with instruction-only interaction mode. This finding is consistent with findings of studies by Hajizainuddin and Melara.¹⁹ Both of these found no significant differences in the relationship between the two different types of WBI and achievement.

This finding may be due to limitations of the study. First, the duration of the experiment (three weeks) may have been too short to observe small, but significant differences and may not have been long enough to see an effect of different types of WBI. Second, there was a low frequency of utilization of the chat room and the bulletin board by subjects in treatment one. Only ten subjects (10.4%) used both the bulletin board and the chat room three times (that is, once a week for each).

Reasons for lower than anticipated utilization of the chat room and bulletin board by students may relate to the level of their skills using the WWW, in typing the Thai language, and their view of the status of the Logical Thinking course. According to demographic data, participants' experience with the Web varied considerably, with over sixty five percent (65%) of each treatment having less than one year of experience. In addition, typing the Thai language on a keyboard designed for the Roman alphabet is more difficult than typing European languages. In the Thai language, there are 44 consonants, 32 vowels, multiple levels for most words, as well as tonal symbols. Finally, the Logical Thinking course is a general education course and may not be viewed by students as warranting as much extra effort as their major courses. These three factors may have diminished students' enthusiasm for participating in the social interaction part of the WBI of this course.

Cultural factors may be equally important. It is common knowledge that Thai, and most other Asian, students feel less free to express themselves in a classroom or other exposed setting than do their Western counterparts. This would include a chat room or bulletin board, where student comments and thoughts expressed would be available for all to view. This reticence is simply a cultural difference and not related to students abilities. Thus, one would not expect Thai students to utilize the chat room or bulletin board to the same extent as a Western cohort, just as one would not observe Thai students asking as many questions openly in a classroom as Western students.

Ho₃: The interaction between learning style and type of WBI will have no effect on achievement.

The null hypothesis 3 is accepted since the interaction between treatments and learning style was not significantly different (Sig.=0.365 when n=199 and Sig.=0.336 when n=195). This means that the interaction between learning style and type of WBI has no effect on achievement. This finding is consistent with findings of a study by Hajizainuddin (1999) in which it was observed that there was no difference in interaction between active and reflective learners, and hierarchical and network structure of WBI in achievement. In his study, Hajizainuddin examined the interaction between learning styles and selected hypermedia organizational structures (hierarchical and network design) used in developing WBI. The participants were divided into two groups according to their learning styles as defined by Kolb as active or reflective learners. One group worked on the WBI using hierarchical design and the other worked with the network design. Both groups were assigned to work in the same course entitled, Computers in Education.

Results from the interaction effect revealed no significant differences between the four types of learning styles and the two types of WBI. This indicated that WBI with social and instructional modes of interaction and WBI with instruction-only interaction mode were equally effective in accommodating learners who were identified as any of the four types, Convergers, Divergers, Accommodators, and Assimilators. It was shown that for all students there was a significant improvement during the period between the pre-test and the post-test. This means that regardless of learning style, all students learned significantly from Web-based instruction.

SUMMARY

The results of this study showed that there was no difference among the four types of learning styles in the amount of learning obtained, although a difference in the main effect between two types of these types of learning style (Converger and Diverger) did exist. The results also showed that there were no differences in the main effect between these two types of WBI or in the interaction effect among all learning styles and WBI.

Based on these findings, a general conclusion can be made that there appears to be no clear relationship between the learning style and achievement in a WBI activity. There appears also to be no relationship between the interaction modes of WBI and performance. Individual learning style for either WBI with social and instructional interaction mode or WBI with instruction-only interaction mode does not affect the achievement.

Although there were no significant differences found for the research questions posed, a significant difference in the main effect did exist between the pre-test and post-test. Therefore, the major conclusion of this study should be that all students of all learning types learned from the WBI offered.

The results of this study indicated that regardless of learning style and types of WBI, all students learned. As a result, three implications arising from this study apply to designing and using WBI for LIS distance education. First, WBI can be used to facilitate LIS distance education since all students learned from it. Second, it might not be necessary for an instructional designer to accommodate for social interaction in designing WBI for teaching a course for different types of learners. This is because the results of the present study showed that students with four different types of learning styles did not show significant differences in achievement when using two different types of WBI. Third, cultural factors in terms of interaction and communication should be considered in designing WBI. WBI may not increase interaction in distance education for all cultures, since the present study found that Thai students had a low frequency of utilization of the social interaction mode in WBI.

Schools of LIS in Thailand and elsewhere, and CPE providers may consider WBI as an appropriate medium for teaching courses at a distance. However, in order to be successful, recommendations are made to instructors, and to the university administrators. For instructors, it is a requirement to exert much effort from the stage of developing the WBI to the stage of using it for teaching and learning. In developing the WBI, it is recommended that instructors follow the ISD model, in which pre-planning and careful organization is needed. A good typing ability is required. Thai, or any language that has a different alphabet requires special attention for keying responses. Instructors have to respond to students by sending them a message via email, posting some messages on the bulletin board or chatting with them through the chat room. An inability to type causes extreme delays in communicating online.

Successful WBI also requires good support from university administrators and CPE funders. They must make a long-term commitment concerning enough resources, especially technology. This includes service volume and technical support from the computer center. This commitment should start at the stage of developing WBI and continue throughout the life of the course.²⁰

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