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Exploring E-learning Effectiveness Based on Activity Theory: An Example of Asynchronous Distance Learning

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ABSTRACT: *E-learning is gaining its weight in business and school education. Previous studies focused on platform construction and teaching material development, while adoption and management issues were neglected. This is prejudicial to e-learning success. To eliminate the gap, the paper conducted an empirical study to understand critical factors of e-learning success. Based on the activity theory, we proposed a framework to examine factors influencing e-learning effectiveness. Two hundred and forty-two learners joined the on-line education project in Chai-Yi county (i.e. an asynchronous distance learning program), volunteered to participate in the survey. The results show that learning motivation, e-learning platform experience, attitude toward Internet, computer self-efficacy, and prior experience were found to significantly influence the e-learning effectiveness. Suggestions to learners, instructors, and platform managers are also provided.*

KEYWORDS: *E-learning, Asynchronous Distance Learning, Activity Theory, Learning Effectiveness.*

1. Introduction

The Internet brought brand new information exchange channel. Different kinds of knowledge are rapidly accumulated and changed over the Internet. E-learning based on the Internet soon boomed. With the power of the Internet, e-learning can be made anytime and anywhere, bringing substantial efficiency improvement and cost reduction. From earlier aided education at schools, e-learning is now applied in internal education training at businesses as a major business model (Ruiz, Diaz, Soler, & Pérez 2008; Wang, Wang, & Shee, 2007). Global Industry Analysts' eLearning: A Global Strategic Business Report pointed out that e-learning market cap in the U.S. reached USD1.75 billion in 2007 and the figure is expected to rise to USD5.26 billion in 2010 (Kopf, 2007). Rosenberg (2001) also expressed that the next killer app over the Internet will be in education.

Baldwin and Ford (1988) found that cost on development training in the U.S. a year was close to 100 billion USD and less than 10% brought real learning achievements. Similar problems can be found in e-learning. A great number of factors affect learning training performance. Schools and businesses are focusing on how to make good planning to obtain substantial effects.

In the past, study of e-learning can be divided into two schools. One school focused on the construction of e-learning software platform or the development of digital teaching materials (Cheung, Hui, Zhang, & Yiu, 2003; Ruiz et al., 2008). The other school paid attention on the introduction, adoption and post-adoption management issues (Selim, 2007) or on the continual using of the e-learning system (Chiu and Wang, 2008; Limayem and Cheung, 2008; Santhanam, Sasidharan and Webster, 2008; Wang et al., 2007). Adotpion-based researches indicate that many factors contribute to the successful implementation of innovative information technology. A couple of failed cases illustrate the importance of mastering those key factors. The main reason is a lack of good control on personnel, technology, and cost before and after introduction. However, there is no research discussed above issues in e-learning. This is the study motive of the research.

The purpose of this study is to explore factors which affect e-learning performance. We attempt to understand how learning performance is affected by individual differences and the interaction between learners and e-learning system. The research target was on-job teachers at elementary and junior high schools who took part in one online Study program for On-job Teachers in Chiayi County, 2001. From behavioural and technical perspectives, this research explores how learners' qualities, experience and feelings of teaching system affect the learning effectiveness and satisfaction. Activity theory was adopted as theoretical support since this thoery provides a complete framework to explain how people are affected by tangible and intangible tools when engaging in activities. It includes three components: subject, tool and object (substantial or abstract). Outcomes are generated through the interactive effects and transference among the three components. This research attempted to apply activity theory in e-learning context to under the how the learning performance (outcome) can be achieved through the process that learners (subject) obtain knowledge (objective) thorugh the using of e-learning platform (tool). After reviewing related literature and collecting required data for analysis, key factors affecting e-learning effectiveness and satisfaction were identified. The results of this study can be of the reference for system developers, programmers, platform operators, teachers and relevant personnel in e-learning in the hope to build a successful e-learning environment.

In the following sections, we first introduce e-learning and activity theory. Factors affecting learning performance and measurement of learning performance are then

derived. In the next, research methods is introduced. Data analysis process and outcome discussion is provided is followed by the conclusion.

2. Literature review

2.1 E-learning

In the broad sense, e-learning can be viewed as learners obtain knowledge through electronic media, including the Internet, business intranet, interorganization network, satellite broadcasting, cassette tapes, interactive TV, and CD-ROMs (Urdan and Weggen, 2000). In the narrow sense, e-learning refers to the take place of learning activities over the Internet (Wang et al., 2007). In this research, e-learning is defined as individuals learn via information and communication technology. According the definition, the take place of learning behaviours is free from the limitation of time and space so that learners can receive training or effects information immediately in order to enhance working performance.

2.2 Activity theory

Activity theory was originated from Russian psychologist, Vygotsky (1978). The initial idea is to provide a framework to explain how people are influenced by tangible and intangible tools while engaging in activities. Leontiev (1981) further developed it into a theoretical concept used widely in pedagogy, anthropology, and linguistics (Hasan and Gould, 2001). The main idea of activity theory is that subjects of activities interact with objects (substantial or abstract), facilitated by tools, to obtain the transformed outcome. The tools here can be substantial and visible things. It can also be less substantial or intangible ideas. Objects are targets that subjects attempt to reach with the use of tool (Figure 1).

This theory is broadly adopted by education researchers. For example, Lim and Hang (2003) provided a systematic approach, based on activity theory, to study the ICT embedded teaching performance in Singapore. Uden (2007) applied activity theory on the design of mobile learning mechanisms. Liaw, Huang and Cheng (2007) explored individuals' attitude toward e-learning based on activity theory and proved that this theory is appropriate for understanding e-learning.

Based on activity theory, we articulate learning activities performed by learners on online system. That is, the entire learning activity includes subject (learners), tool (learning system), object (to obtain knowledge) and outcome (learning effects and satisfaction). This study aims at understanding how individual differences and the interaction between learner and system affect learning effectiveness and satisfaction (outcome) when learners (subject) attempt to obtain knowledge (object) through e-learning systems (tool).

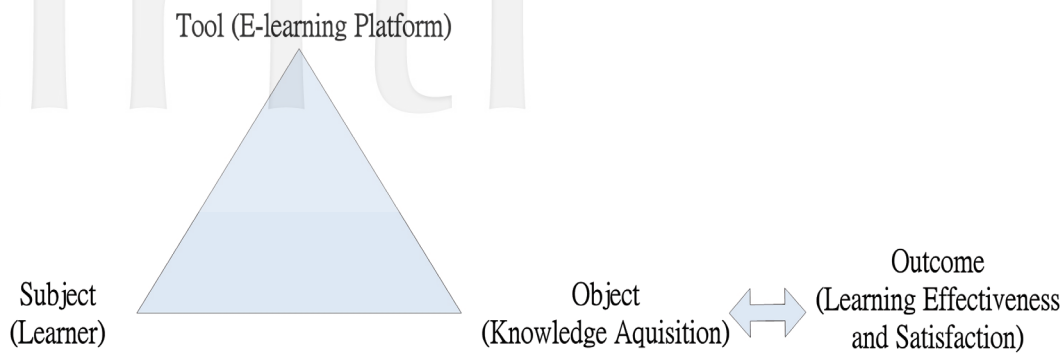

Figure 1 Activity Theory (Nardi, 1996)

2.3 Factors affecting learning training performance

After summarizing earlier studies, factors affecting learning performance can be categorized into individual- and system-related two dimensions:

2.3.1 Individual dimension

2.3.1.1 Learning styles

Learning styles, originated from cognition styles, were used to explain the influence of individual cognition on learning effects in the early stage. Kolb (1976) proposed experience learning theory and divided learning stages into concrete experience/abstract ideas and active experiment/reflection and observation in diverger, assimilator, converger and accommodator learning styles (Figure 2).

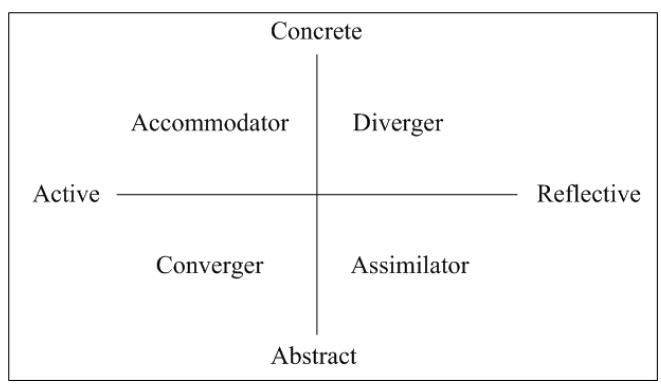

Figure 2 Learning Style (Kolb, 2001)

2.3.1.2 Computer self-efficacy

Compeau and Higgins (1995) viewed computer self-efficacy as the confidence level of individuals on using computers. Computer self-efficacy has an effect on learning

effectiveness. For example, Tam (1996) indicated that computer self-efficacy generates significant influence on the learning of information technology. Therefore, computer self-efficacy should be taken into accoung while study e-learning since it is made via information technology (Piccoli, Ahman and Ives, 2001).

2.3.1.3 Learning motivation

Learning motivation is an inner mental process which maintains learners' learning activities and also an important factor affecting learning training effects (Piccoli et al., 2001; Tracey and Tews, 1995). Pintrich and De Groot (1990) pointed out that learning motivation includes values, expectation and emotions. Values refer to reasons for learning, importance on the work, and effect degree or interest. It includes learners' inner and outer goal orientations as well as work values. Expectation means one's belief toward the accomplishment of a job, belief toward control, and expectation on success. It includs learning self-efficacy, control belief, and success expectation. Emotions cover learners' emotional reactions to learning, such as test anxiety.

2.3.1.4 Previous experience

People tend to mix external stimulation with their current knowledge or experience. The level of experience determines the level of mixture, leading to different attitudes, intentions and behaviours. Therefore with or without previous experience and the level of experience affect people's perception toward the using of information technology (Taylor and Todd, 1995). Piccoli et al. (2001) pointed out that learning success in virtual learning environment may be affected by previous experience. Specifically, appropriate learning strategies can be developed when learners have more previous experience. Hence, learning performance is affected by previous experience toward computer and experience of taking web-based courses.

2.3.2 System dimension

2.3.2.1 Attitude toward e-learning media

Attitude refers to propositions toward those emotion factors, feeling of use, control and behaviours on objects from information technology (Selwyn, 1997). Some salient examples are anxiety on information operation, whether information technology is of use, whether self-operation is possible and whether to engage in information technology activities. Chen (2008) indicated that learning satisfaction is a function of learners' attitude toward e-learning. Earlier studies also pointed out that learners possess negative attitudes toward the Internet tended to communicate with other thorugh different mediums. The lack of other communication mediums is a barrier of achieving high learning performance.

2.3.2.2 Experience of using e-learning systems

Under e-learning context, learners access course materials and interact with peers and teachers through e-learning systems. Learner's intention or willingness to use the system is affected by perceived easefulness and ease of use toward the system. Willingness determines using frequency and, in turn, affects learning effectiveness and satisfaction (Limayem and Cheung, 2008; Chen, 2008).

2.3.2.3 Learning performance measurement

Learning effectiveness and satisfaction were used to measure learning performance in earlier studies. Learning effectiveness is to understand whether lerners gain basic knowledge and understand major issues of courses. For both academic and pratitioner, satisfaction was used broadly to measure learning performance (Alavi and Leidner, 2001). In this paper, satisfaction toward learning platform is not considered since system was viewed as a tool which facilitate learning activities and knowledge acquisition. Instead, we focused on learners' satisfaction toward course and teachers. The former represents learners' satisfaction toward course arrangement and measures usability and interest level of the selected course. The latter focuses on learners' perceived qualities of teachers, such as knowledgable level, course organization, fairness of giving scores, and interaction with students (Arbaugh, 2002; Hiltz, 1994).

3. Research method

3.1 Research framework

This paper discussed factors affecting e-learning effectiveness and satisfaction thorugh constructing online learning activities based on activity theory. We porposed that learning activities include subject (learners), tool (learning system), object (obtaining knowledge), and outcome (learning effectiveness and satisfaction). The research framework is shown in Figure 3.

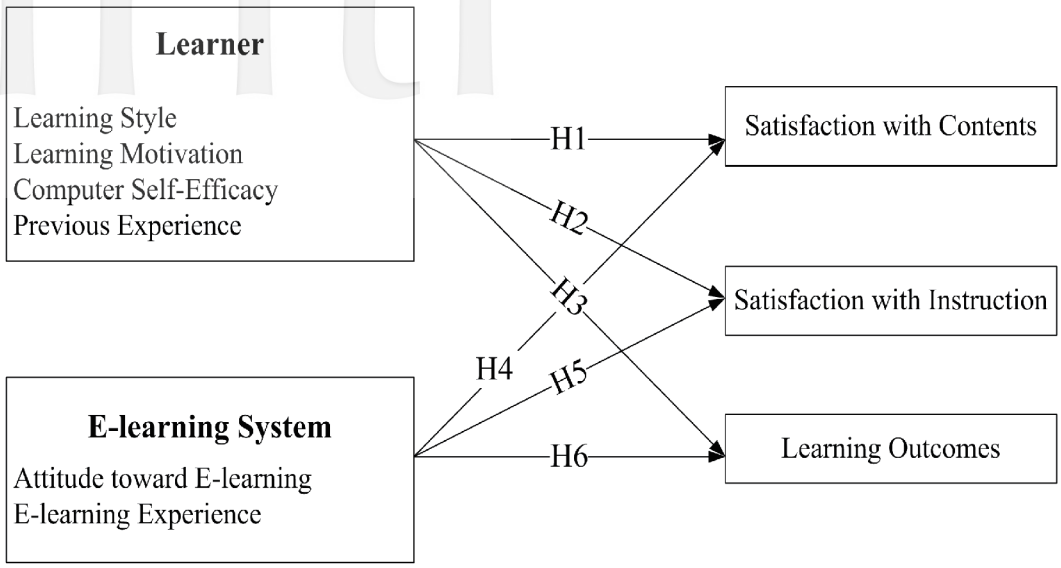

Figure 3 Research Model

3.2 Research hypothesis

Earlier studies showed that learners are a major factor affecting e-learning performance (Piccoli et al., 2001). Learning style (Cano-Garcia and Hughes, 2000), learning motivation (Pintrich and De Groot, 1990), previous experience, computer self-efficacy (Piccoli et al., 2001) and experience (Taylor and Todd, 1995) affected e-learning performance (learning satisfaction and effectiveness) (Zhang, Zhou, & Briggs, and Nunamaker, 2006).

H1: Learners factors (learning styles, learning motivation, computer self-efficacy, and previous experience) affect satisfaction toward course content.

H2: Learners factors (learning styles, learning motivation, computer self-efficacy, and previous experience) affect satisfaction toward teaching.

H3: Learners factors (learning styles, learning motivation, computer self-efficacy, and previous experience) affect learning effectiveness.

Learn performance is also affected by experience and feelings toward e-learning system. Several scholars have also proven that learners' attitudes and experience of e-learning affected learning performance (Chen, 2008; Limayem and Cheung, 2008; Liu, Liao and Pratt, 2009).

H4: System factors (attitudes to e-learning media, e-learning experience) affect learners' satisfaction toward course content.

H5: System factors (attitudes to e-learning media, e-learning experience)) affect satisfaction on teaching.

H6: System factors (attitudes to e-learning media, e-learning experience)) affect learning effects.

3.3 Research scope and target

Subjects of this study are on-job teachers who took part in one online program designed for On-job Teachers in Chiayi County, 2001. Most of schools are located in suburban areas with limited public transportation support. However, the well-constructured academic network and e-learning system provided those teachers a mean for on-job training. We collected data from those teachers enrolled in seventeen online courses during November 2001 and May 2002.

3.4 Questionnaire design

3.4.1 Independent variables

A total of 14 questions adopt from Romero, Tepper and Tetrault (1992) were used to understand each individual's learning styles. Kolb concluded four types of learning style. Odd number questions were for abstract ideas and concrete experience dimension (abstract); even number questions were for active experiment and thinking/observation (active). A total of 10 questions adopt from Compeau and Higgins (1995) were used to measure computer self-efficacy. Subjects first answer whether they are confident on each question and, if the answer is positive, then circle a number from 1 to 10 to represent the degree or confidence. For learning motivation, a total of 35 questions, covering value, expectation, and emotions, adopted from Pintrich and De Groot (1990) were used. In previous experience, Questionnaire developed by Hiltz (1994) was used to understand each individual's previous experience. Subjects were asked to state the time they had contact with computer before, experience of using computer and number of times taking web-based courses. Finally, a total of 4 (attitude toward medium) and 6 (experience in using e-learning) questions adopt from Hiltz (1994) were used to understand system level factors. All questions in Likert scale anchoring from 1 (strong disagree) to 5 (strong agree).

3.4.2 Dependent variables

Questions to measure learning effects and satisfaction questionnaire were developed by Hiltz (1994). Satisfaction covers course contents and teaching two dimensions and there are 11 questions for each dimension respectively. A self-report based instrument was used to measure learning effects since objective score is not available. A total of 27 questions adopt from Marcolin, Compeau, Munro, and Huff (2000) were used to measure

learning effectiveness. Are questions are in Likert scale format anchoring from 1 (strongly disagree) to 5 (strongly agree).

Draft of questionnaires were first examined and revised by experts. Five testees took pre-test to make sure that they had identical understanding of the questions. The final version includes personal data, learners, system and learning results were then derived.

3.5 Web-based learning platform

The system used in this study, named "Chiayi County Web-based Learning Center (http://eworkshop.webedu.ccu.edu.tw)", is developed and authorized e-learning center in National Chung Cheng University. This system includes required e-learning functions, such as the latest news, course information, teaching materials, self-evaluation, discussions and personal tool (Figure 4).

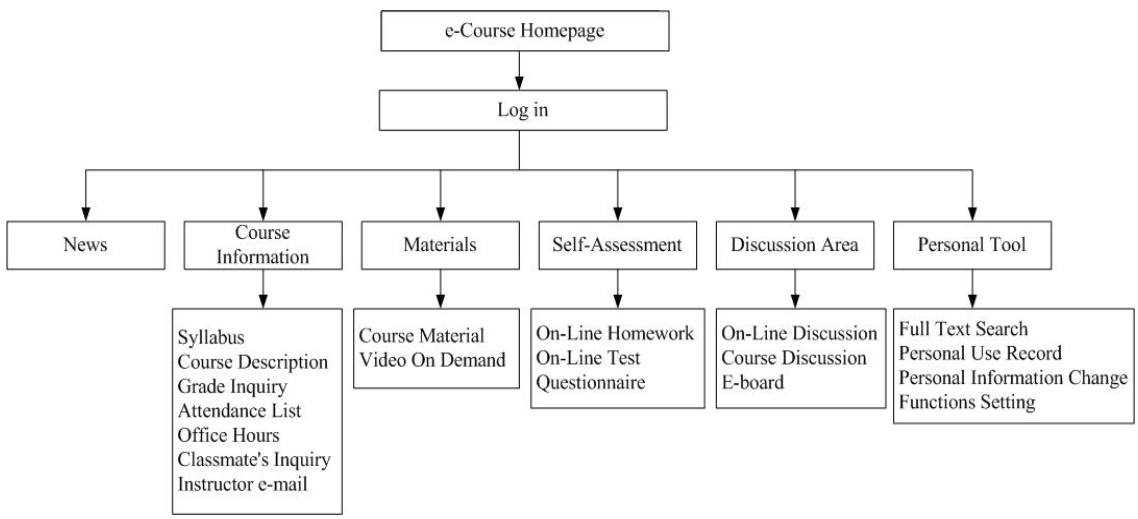

Figure 4 The E-learning System

3.6 Data collection

Questionnaires were delivered to sujects via traditional mail and over the Internet. Three-waves data collection was done between mid April and mid May 2002. Initially, questionnaires were mailed to all teachers participated in the first wave data collection. For the second wave, some were deleivered through mails and some were handed during the face-to-face meeting. All participants in the third wave wave filled the survey during the face-to-face meeting (one for each semester). Instructor of each course helps delivering and collecting questionnaire. Those failing to complete questionnaires in class were asked to submit their answers over the Internet. Incomplete responses were reconfirmed via e-mails or paper copies. There were 488 registered learners and 259

copies were collected. After removing 17 useless questionnaires, there were 242. The final response rate is 49.5%

4. Data analysis and discussion

4.1 Demographic

Most respondents were female (approx. 70%), with college degree (approx. 93.5%), or under 40 years old (approx. 96%). Around 60% of learners had computer experience for more than six years and over 80% of them use computer frequently. Around 70% of them took web-based courses for more than two times.

To assure that our sample can truly represent the population, we compared the genders and education level between sampled data and population. No difference was found.

4.2 Reliability and validity

Reliability was measured with Cronbach's α. Reliability of all dimensions was over 0.7 showing certain reliability of the questionnaire (Appendix I).

We also tested content and construct validity of the instrument. All items were adapted from past researches. Questionnaire was first translated into Chinese and checked by two experts for syntax and grammar errors. Comparison and required modification were made and, therefore, content validity is assured. Exploratory factor analysis was used to test construct validty since certain constructs were translated into different language. The KMO (0.904) and Bartlett test of sphericity (less than 0.05) show that our data is suitable for conducting factor analysis. According to Hair, Anderson, Tatham, and Black (2006), factor loading should not be lower than 0.4 when sample size is no more than 250. Therefore, questions 3, 4, 7, 9, 10, 11, 12, 15, 16, 21, 30, 31, and 34 in learning motivation were deleted. Question 3 in attitude toward e-learning, questions 4, 8 and 10 in course content, question 4 in satisfaction with instruction and questions l12, 16, 23, 24, 25, 26, and 27 in learning outcomes as well as questions 3, 9, 16, 21, and 31 in motivation emotion were deleted. Learning motivation was excluded as a result (Appendix I). Questions 8 and 14 in learning motivation-value were moved to learning motivation-expectation; questions 13 and 20 in learning motivation-expectation were moved to learning motivation-value. Three major factors were extracted in dependent variables: satisfacton with contents, satisfaction with instruction, and learning effectiveness. Question 5 in satisfaction with instruction was moved to satisfacton with contents. Factor analysis results also showed convergent validity and distinction effectiveness of variables (Appendix I).

4.3 Non-response bias test

To check if there was non-response bias, paired t-Tests were made on collected questionnaires from three waves. Differences were not significant. In each wave, p exceeded 0.05, which indicates not significant and, therefore, non-response bias is not an issue in collected data.

4.4 Correlation analysis

Before regression analysis, correlation among variables was first confirmed with Pearson correlation coefficient to determine statistics methods in the next step. Test results (Table 1) showed that variables have medium/low correlation and it is not appropriate to conduct several multiple regression analysis separately. Hence, multivariate multiple regression was used for hypotheses testing.

Table1 Person Correlation Coefficients

	Satisfaction with Contents	Satisfaction with Instruction	Learning Outcomes	Computer Self-Efficiency	Attitude toward E-learning	E-learning Experience	Learning Motivation-Expectancy	Learning Motivation-Value
Satisfaction with Contents	1.000							
Satisfaction with Instruction	0.674 (0.000***)	1.000						
Learning Outcomes	0.611 (0.000***)	0.667 (0.000***)	1.000					
Computer Self-Efficiency	0.132 (0.041*)	0.289 (0.000***)	0.286 (0.000***)	1.000				
Attitude toward E-learning	0.406 (0.000***)	0.451 (0.000***)	0.477 (0.000***)	0.113 (0.000***)	1.000			
E-learning Experience	0.388 (0.000***)	0.336 (0.000***)	0.377 (0.000***)	0.275 (0.079)	0.438 (0.000***)	1.000		
Learning Motivation-Expectancy	0.308 (0.000***)	0.313 (0.000***)	0.561 (0.000***)	0.293 (0.000***)	0.359 (0.000***)	0.262 (0.000***)	1.000	
Learning Motivation-Value	0.523 (0.000***)	0.501 (0.000***)	0.619 (0.000***)	0.350 (0.000***)	0.333 (0.000***)	0.373 (0.000***)	0.607 (0.000***)	1.000

Note: Value in brackets are p value; ** $p < 0.001$; * $p < 0.05$

4.5 Multivariate multiple regression

General Linear Model (GLM) function in SPSS was used to test developed hypotheses. Since learning style is categorical data, a totoal of three virtual variables, DV1, DV2 and DV3 were used to represent four different learning styles. In addition, for learning motivation, only value and expectation were remained in the analysis. Overall model analysis results showed that computer self-efficacy, learning motivation-value, learning motivation-expectation, e-learning experience, and attitude toward e-learning have significant effect on learning performance. That is, satisfacton with contents, satisfaction with instruction, and learning effectiveness are affected by those variables. Previous experience and learning styles were not significant.

Regression coefficient test was conducted to understand the influence of each independent variable on dependent variables. Table 2 showed that learning motivation-value, e-learning experience, and attitude toward e-learning had positive and significant influence on satisfacton with contents. Learning motivation had greatest influence, followed by e-learning experience and attitude toward e-learning. Computer self-efficacy, learning motivation-value, previous experience, e-learning experience, and attitude toward e-learning had significant influence on satisfaction with instruction. Except for previous experience with negative influence, the rest had positive influence. In learning effect, learning motivation-value, learning motivation-expectation, and attitude toward e-learning significantly affected learning effectiveness. Relation among all independent and dependent variables was positive.

Table 2 Regression Results on Predicting Learning Effectiveness

	Satisfaction with Contents			**Satisfaction with Instruction**			**Learning Outcomes**		
	β	**t**	**p-value**	**β**	**t**	**p-value**	**β**	**t**	**p-value**
Learning Style (DV1) [a]	0.029	0.336	0.737	-0.042	-0.498	0.619	-0.024	-0.348	0.728
Learning Style (DV2) [b]	0.097	1.273	0.204	0.115	1.553	0.122	0.012	0.200	0.842
Learning Style (DV3) [c]	0.107	1.446	0.150	0.067	0.929	0.354	-0.039	-0.657	0.512
Computer Self-Efficiency	-0.008	-0.557	0.578	0.035	2.605	0.010*	0.018	1.572	0.117
Learning Motivation-Expectancy	0.296	3.804	0.000***[d]	0.291	3.822	0.000***	0.210	3.340	0.001**
Learning Motivation-Value	0.017	0.227	0.821	-0.063	-0.860	0.390	0.150	2.461	0.015*

Table 2 Regression Results on Predicting Learning Effectiveness (Continue)

	Satisfaction with Content			Satisfaction with Instruction			Learning Outcomes		
	β	t	p-value	β	t	p-value	β	t	p-value
Previous Experience	-0.078	-1.456	0.147	-0.109	-2.079	0.039*	-0.037	-0.854	0.394
Attitude toward E-learning	0.236	4.121	0.000***	0.130	2.315	0.021*	0.075	1.635	0.103
E-learning Experience	0.115	2.174	0.031*	0.182	3.513	0.001**	0.182	4.256	0.000***

Note: Standardized Regression coefficients are reported; *p < 0.05, ** p < 0.01, ***p < 0.001; DV1 is dummy variable 1; DV2 is dummy variable 2; DV3 is dummy variable 3.

4.6 Discussion

Based on satisfacton with contents, satisfaction with instruction, and learning effectiveness, discussion were made per individual regression analysis significance.

4.6.1 Satisfacton with contents

Learning motivation-value, e-learning experience, and attitude toward e-learning had significant influence on satisfacton with contents.

4.6.1.1 Learning motivation-value

Learning motivation-value had greatest influence on satisfacton with contents, secondly e-learning experience and then attitude toward e-learning. Samples in this study were on-job teachers having voluntary study through e-learning. It was believed this activity and course content would benefit their future teaching.

4.6.1.2 E-learning experience

E-learning experience measurement included feeling (e.g., easy to learn, friendly, no frustration, productive) and experience (e.g., learning efficiency and quality increase). E-learning was like traditional classrooms, if e-learning system provided appropriate, easy-to-use and learning tools for the course, learners could study without problems. It was easier for them to feel and learn from teaching materials and better master learning goals. They would naturally had satisfaction with contents.

4.6.1.3 Attitude toward e-learning

Attitudes to media determined whether learners would be enjoy in learning. In e-learning, teachers decided materials and learners studied on their own and submitted assignments or had group discussions on the web. Learners with positive attitude toward e-learning better got involved in system learning and were more likely to use the system

again in the future (Carswell and Venkatesh, 2002). However, learners with negative attitude toward e-learning tend to be more unwilling to use the environment and became less concentrated that would affected satisfacton with contents.

4.6.2 Satisfaction with instruction

Influence of computer self-efficacy, learning motivation-value, previous experience, attitude toward e-learning, and e-learning experience on satisfaction with instruction was significant.

4.6.2.1 Computer self-efficacy

Learners with higher computer self-efficacy better understand the course content. They would have greater satisfaction with instruction; if learners believed they could not control computer and the web, they tended to stop in problems and even gave up communication over computer to have real time and effective help from teachers. Thus, satisfaction with instruction was reduced.

4.6.2.2 Learning motivation-value

If learners believed knowledge from teachers and experience sharing would benefit their future work, they regarded such learning with higher value, which enhanced satisfaction with instruction.

4.6.2.3 Previouis experience

Previous experience was negative to satisfaction with instruction. The possible reason was, when learners had less computer experience or never took web-based courses, they were more likely attracted by new teaching environment and felt positive about teachers. As they got familiar with web-based learning, they focused on courses content and requested more feedback and teaching skills from teachers. Provided teachers failed to offer real time and effective response, learners would believe teachers did not fully get involved, which led to lower satisfaction with instruction.

4.6.2.4 E-learning experience

Learners that felt e-learning easy to use had positive use experience. If learners were more willing to use the system use the system frequently in longer time, and they had more time interacting with teachers and felt teachers' effort. This resulted in higher satisfaction with instruction.

4.6.2.5 Attitude toward e-learning

E-learning was mainly on entry (speaking) and viewing texts (listening). Learners were not used to use keyboard would led to lower participation in class due to slow

entry or entry mistakes; those not used to reading on the screen had inferior absorption and comprehension; without real time communication with teachers in verbal or body language, problems could not be solved right away. These affected satisfaction with instruction.

4.6.3 Learning effectiveness

Influence of learning motivation-value, learning motivation-expectation, and attitude toward e-learning is significant on learning effectiveness.

4.6.3.1 Learning motivation-value

Most of learners taking web-based courses had high learning motivation-value and had certain interest in course content. They hoped to learn knowledge in e-course. This corresponded to high learning effectiveness from learning motivation in earlier studies.

4.6.3.2 Learning motivation-expectation

Higher learning motivation-expectation meant that learners were eager to have successful learning, which was reflected in learning effectiveness. In general, learners with higher learning motivation tend to learn actively and got more involved in courses with more time and energy. They even had self-thinking and learning results were often better.

4.6.3.3 Attitude toward e-learning

Statements had to be given via keyboard in e-learning and information had to be accessed via screen. Operation and browsing are different from traditional reading books. Learners familiar with Internet operation or positive attitudes were easier to engage in learning to obtain knowledge and increase learning effectiveness.

Results from test corresponded to those of Lu, Yu and Liu, (2003) that learning styles did not significantly affect learning effectiveness and satisfaction. This was a lot of different from study results in traditional teaching methods. In traditional teaching, teachers adjusted teaching model to meet learners' response in different learning styles. Therefore, learners felt higher learning effectiveness and satisfaction. In e-learning, teachers gave students with pre-prepared teaching materials and pre-recorded teaching content for learners to self-study. There was no customized teaching model for different earning styles. Learners were unable to have different feeling in learning effectiveness and satisfaction.

5. Conclusion

5.1 Conclusion

The empirical results showed learning motivation-value, e-learning experience and attitude toward e-learning had significant influence on satisfacton with contents; learning motivation-value, attitude toward e-learning, e-learning experience, computer self-efficacy and experience of using computer affected satisfaction with instruction; learning effectiveness was affected by learning motivation-value, learning motivation-expectation, and attitude toward e-learning.

5.2 Research limitations

Samples in this research were teachers at elementary and high schools participating in web-based learning in Chiayi County. Most of them had basic ability of computer operation and completed college education. It was inferred that they had basic information technology ability. Therefore, individual information technology ability was not included in the study scope.

In the 17 instructors, only 5 had experience of teaching at web-based courses. Teaching method or style over the e-learning platform should not be significantly different. The findings showed learners did not show significant difference in satisfaction with instruction ($t = 0.974$; $p = 0.325$) and learning effectiveness ($t = 0.162$; $p = 0.688$) from teachers with and without web-based course experience. Teaching with web-based course experience was not included in the study.

The purpose of the research subject-Chiayi County Teacher Information Application of Web-base Courses Project was to see if learners passed the standard, and no scores were given. Hence, self-report was used to measure learning effectiveness and satisfaction. Teaching materials from each course to learners were the same. Therefore, learning styles were not considered.

5.3 Suggestions

For platform designers, the research proved learning motivation-value did have significant influence on learning effectiveness. System friendliness, easy to use and convenience should be improved to make learners enjoy using and understanding course contents and help from teaching. The research found better e-learning experience and attitudes led to higher satisfacton with contents and instruction, and learners more like electronic platform and had better learning effectiveness.

Secondly, e-learning operators should concern learners' using experience and have close communication with platform designers. After new functions are available,

operators must find real users to have test of actual use in interaction in order to improve system functions, response time, and poor interaction (Pituch and Lee, 2006). This will help increase learners' satisfaction to continually use the platform for learning (Limayem and Cheung, 2008) and keep their loyalty.

Thirdly, teachers shall enhance learners motivation-value and spend more time on preparation for courses to clearly master course key points and contents in sound organization with comments. They are required to pay more attention to arrange course content priority and difficulty to help learners comprehend course content and enhance satisfaction with instruction and learning effectiveness.

For scholars interested in study of e-learning, this research provided a model based on activity theory framework. There is, however, group activity framework in addition to activity theory. Further research can be made in this field. In recent years, artificial intelligence mechanism had been introduced to e-learning study field (Gladun et al., 2009). Further exploration on technology and management of artificial intelligence in learning is recommended.

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Appendix: Questionnaire, reliability, and validity

Student ID: Gender: ☐Male ☐Female

Age: ☐Less than 20 ☐21-35 ☐26-30 ☐31-35 ☐36-40 ☐41-45 ☐46-50 ☐Over 50

Education: ☐Bachelor ☐Master or above

Frequency of participating in e-learning course: ☐Never ☐One ☐Two ☐Over three

Learning method: ☐On computer screen ☐Hard copy ☐Both

Time spending in this course every week: ☐Less than 3 hours ☐3-6hours ☐6-9hours ☐Over 9 hours

Frequency of computer use: ☐Unusually ☐Sometime ☐Often ☐Usually

Prior experience of computer: ☐Less than 1 year ☐1-5 years ☐6-10 years ☐Over 10 years

Computer Self-Efficacy (Cronbach's α=0.958)			
I can use e-learning system, if there was no one around to tell me what to do as I go.	***0.770***	0.085	0.189
I can use e-learning system, if I had never used a package like e-learning system before.	***0.764***	0.100	0.224
I can use e-learning system, if I had only the e-learning system manuals for reference.	***0.871***	0.063	0.100
I can use e-learning system, if I had seen someone else using e-learning system before trying it myself.	***0.894***	0.093	-0.047
I can use e-learning system, if I could call someone for help if I got stuck.	***0.858***	0.038	-0.068
I can use e-learning system, if someone else had helped me get started.	***0.876***	0.116	-0.082
I can use e-learning system, if I had a lot of time to complete the job for which the e-learning system was provided.	***0.866***	0.140	-0.014
I can use e-learning system, if I had just the built-in help facility for assistance.	***0.814***	0.088	0.122
I can use e-learning system, if someone showed me how to do e-learning system first.	***0.906***	0.130	0.002

I can use e-learning system, if I had used similar packages before this one to do the same job.	***0.866***	0.157	-0.048
E-learning Experience (Cronbach's α = 0.859)			
Hard to learn	0.211	***0.838***	0.102
Impersonal	0.050	***0.811***	0.199
Frustrating	0.194	***0.833***	0.140
Unproductive	0.041	***0.748***	0.279
Attitudes Toward E-learning Media (Cronbach's α = 0.727)			
I enjoy listening to lectures toward e-learning media.	0.083	0.235	***0.806***
I like to read toward e-learning media.	-0.045	0.126	***0.820***
I like to take to part in class discussions.	0.072	0.249	***0.674***
Learning Motivation-Value (Cronbach's α = 0.881)			
I prefer class work that is challenging so I can learn new things.		***0.430***	0.379
I think I will be able to use what I learn in this class in other classes.		***0.517***	0.298
I'm certain I can understand the ideas taught in this course.		***0.567***	0.368
I like more those contents, I am interested in even if they are not easy to learn in this course.		***0.645***	0.275
I think that what we are learning in this class is interesting.		***0.755***	0.233
I know that I will be able to understand the material for this class.		***0.610***	0.339
It satisfies me that I try to understand all the material for this class.		***0.518***	0.395
I think that what I am learning in this class is useful for me to know.		0.763	0.164
I often choose paper topics I will learn something from even if they require more work.		***0.704***	-0.129
I know that I will not understand the material for this class if I don't study hard enough.		***0.526***	-0.125
I like what I am learning in this class.		***0.796***	0.156
Understanding this subject is important to me.		***0.677***	0.214

Learning Motivation-Expectancy (Cronbach's α = 0.843)			
I know that I will be able to learn the material for this class.		0.382	***0.499***
I think I will receive a good grade in this class.		0.234	***0.731***
Receiving a good grade mostly satisfies me.		-0.112	***0.645***
Compared with other students in this class in this course I expect to do well.		-0.116	***0.689***
I am sure I can understand the complicated material for this class.		0.440	***0.493***
I am sure I can do an excellent job on the problems and tasks assigned for this class.		0.343	***0.710***
I expect to do very well in this class.		0.354	***0.693***
Compared with other students in this class I think I know a great deal about the subject.		0.402	***0.508***
I will be able to understand the material for this class.		0.068	***0.435***
Considering level of difficulty, instruction, and my personal capability, I am sure I can do very well.		0.485	***0.571***
Learning Outcomes (Cronbach's α = 0.937)			
I became more interested in the subject.	***0.493***	0.409	0.457
I learned a great deal of factual material.	***0.579***	0.383	0.348
I gained a good understanding of basic concepts.	***0.552***	0.387	0.329
I learned to identify central issues in this field.	***0.628***	0.295	0.236
I developed the ability to communicate clearly about this subject.	***0.671***	-0.040	0.306
My sill in critical thinking was increased.	***0.750***	0.111	0.127
My ability to integrate facts and develop.	***0.668***	0.097	0.253
I regularly completed the required readings.	***0.537***	0.164	0.105
I was stimulated to do additional reading.	***0.469***	0.280	0.249
I participated actively in class discussion.	***0.487***	0.038	0.470
I was stimulated to discuss related topics outside of class.	***0.521***	0.180	0.408
The written assignments aided my learning.	***0.510***	0.113	0.176

I was forced to think for myself.	***0.624***	0.208	0.253
I became more confident in expressing my ideas.	***0.699***	0.114	0.265
I learned to value other points of view.	***0.563***	0.192	0.035
I was motivated to do my best work.	***0.656***	0.278	0.091
I gained a better understanding of myself.	***0.745***	0.021	0.122
I increased my competence with computers.	***0.636***	0.124	0.154
I learned to see relationships between important topics and ideas.	***0.719***	0.168	0.207
My ability to critically analyze written material was improved.	***0.664***	0.232	0.110
Satisfaction with Contents (Cronbach's α = 0.889)			
The course content was interesting to me.	0.337	***0.434***	0.419
Course content is important or value.	0.292	***0.516***	0.376
Course goals were clear to me.	0.409	***0.510***	0.270
The reading assignments are poor.	0.054	***0.814***	0.011
The written assignments are poor.	0.138	***0.817***	0.058
The lecture material is poor.	0.175	***0.803***	0.081
This course was a waste of time.	0.217	***0.761***	0.049
Overall, I was satisfied the course contents.	0.390	***0.613***	0.299
Students were encouraged to express ideas.	0.159	***0.470***	0.459
Satisfaction with Instruction (Cronbach's α = 0.849)			
Instructor organized the course well.	0.346	0.400	***0.479***
Grading was fair and impartial.	0.025	0.381	***0.483***
Instructor seems to enjoy teaching.	0.089	0.417	***0.437***
Instructor presented material clearly and summarized points.	0.359	0.312	***0.515***
Instructor discussed points of view other than her/his own.	0.309	0.249	***0.540***
The student was able to get personal help in this course.	0.162	0.164	***0.669***
Instructor critiqued my work in a constructive and helpful way.	0.183	0.193	***0.599***
Overall, I was satisfied with the instruction.	0.346	0.449	***0.551***

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