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ICT Integrated in Higher Education: The Activities, Context and Effects

Chih-Yen Huang
Feng Chia University, cyhuang@fcu.edu.tw

Ju-Chuan Wu
Feng Chia University, katejcwu@mail.fcu.edu.tw

Shu-Mei Lee
Feng Chia University, amylee22229@gmail.com

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Chih-Yen Huang
Graduate Institute of Public Affairs and
Social Innovation, Feng Chia University
No. 100, Wenhwa Rd., Seatwen, Taichung,
Taiwan 40724, R.O.C.
cyhuang@fcu.edu.tw

Ju-Chuan Wu
Department of Business Administration,
Feng Chia University
No. 100, Wenhwa Rd., Seatwen, Taichung,
Taiwan 40724, R.O.C.
katejcwu@mail.fcu.edu.tw

Shu-Mei Lee
Department of Business Administration, Feng Chia University
No. 100, Wenhwa Rd., Seatwen, Taichung, Taiwan 40724, R.O.C.
amylee22229@gmail.com

Abstract

Accompanying with the development and advancement of ICT integrated in higher education, it enabled the progressive changes in centered pedagogies and practices. This study attempts to explore the context in ICT integrated education with student perspective and to propose a research model combining with readiness and activity theory to exam the effects of ICT integrated in higher education and the learning performance. 603 questionnaires were collected from the universities in Taiwan and analyzed with AMOS. The results indicate that informational-based readiness has positive effect on user's readiness, user's readiness and schools' ICT support both have positive effects on ICT actual use, and ICT actual use also has positive effect on their perceived satisfaction (performance). The findings could enrich the research of ICT integrated education with different perspectives, and would be helpful to extend to the long-term development in academics and practical ICT application.

Keywords: ICT integration, Higher Education Innovation, Activity Theory, Readiness

Introduction

The purpose of education for individuals is to enable students to develop their talents and interests, and to interact with their inner and outer worlds to help us have a fulfilling life and enthusiasm and productivity (Robinson & Aronica, 2015). Higher education plays an important role to prepare students to be more competitive in the global marketplace. Schools and educational institutions must promote educational reforms that can change traditional teaching practices (Sahlberg, 2006). Since 1990s, the advancement and development of information technology has enabled many information and communication technologies (ICTs) to integrate into the process of innovative teaching (Althunibat, 2015; Fu, 2013). Previous studies indicated that ICT integrated teaching enabled students to have more learning experiences and better performance during the learning process (Robinson & Aronica, 2015; Van Dusen, 2014). Since ICT integrated teaching has changed the teaching and learning methods both of teachers and students, and began to reverse the limitations and deficiencies in traditional teaching. However, literature review has found that ICT has a wide range of application in education and does not have a complete interpretation and definition. Thus, the related activities and elements involving in the ICT integrated innovative teaching is one of the critical issues in higher education. In this study, the Activity Theory is considered as an initial conceptual model while exploring the related activity, context, and content and to exam the effects of ICT integrated in higher

education, and further to illustrate and interpret the use of technology in higher education (Isssroff and Scanlon, 2002) for better understanding the current ICT integrated innovative teaching.

Another adoption factor of ICT-used in the education field is the technical support (De Smet et al., 2012). However, some studies had found that ICT was a barrier to the adoption of users (Walder, 2015; C. Chou & Peng, 2011). Therefore, this is a noteworthy direction whether students are prepared to adapt to these ICT integrated innovative teaching models should also be considered. On the other hand, most of the past researches focused on how to integrate technology into teaching, and the relationship between knowledge, learning, teaching, and multi-media focuses on teaching methods, design, tools, and learning. In addition, the flipped classroom advocated by the academia in recent years are relatively new topics. In the current situation where resources and learning methods become more diverse, the flip-top classrooms should adopt more technological tools to meet individual needs and exclude geographical and time constraints, and effective teaching turns into important research topics for ICT integrated innovative teaching (Al-Emran et al., 2016; Xing et al., 2015; Roach, 2014). Some scholars have also put forward a lot of positive research conclusions and suggestions for flipped classroom (Roach, 2014). Besides the above issues, past studies had paid less attention to the discussion of the factors affecting student acceptance and adoption in higher education (Cheon et al., 2012). This study aims to understand (1) the current multi-learning environment and ICT integrated innovative teaching practice via student perspective through the theoretical framework, (2) the actual adoption and acceptance of students as well as the school's ICT support, whether it will affect the role orientation and future direction of the school and become the motivation and direction of this research. Therefore, the research purpose would be addressed as following: (1) To explore the activity, context and content of ICT integrated in higher education with activity theory framework; (2) To understand the relevance between students' readiness and actual ICT adoption in higher education; (3) To understand the relevance between school ICT support and actual ICT used in higher education; (4) To exam the effects of ICT integrated in higher education as well as the performance of ICT integrated innovation from student perspective.

Literature Review

According to the research purposes, we review the previous studies about ICT integrated innovative teaching and learning, the related theory and theoretical framework for research model and hypotheses developing. The related determinants including user readiness, information-based readiness, ICT support, and satisfaction are also reviewed and illustrated as following.

Information and Communication Technology Integrated Innovative Teaching

The meaning of innovation represents not only creative, namely providing unique and novel ideas, but it could also develop ideas into specific products or achievements and further gain recognition and value. According to the description, this study considers that innovation can be introduced from the individual to the organization itself or from the outside world. From the perspective of Benjamin Bloom's cognitive field teaching objectives, the traditional teaching lectures are transferring to the innovative teaching of today's multi-integration ICT mechanism. And it is expected to promote students to actively learn, explore problems and think deeply in order to truly deep learning and cultivate independent learning ability.

ICT integrated education has become significant innovation on campus such as distance teaching, digital learning, situational simulation, mixed learning mode, and development curriculum-related systems, which are combined with other learning methods such as teamwork and communication to teach. The relevant literatures of innovative teaching can be summarized : (1) innovative teaching modes are undoubtedly expected to enhance students' learning effectiveness (Ferrari et al, 2009); (2) most of researches have focused on innovative teaching methods and design, and lack of the measurement of performance on ICT integrated in higher education with different perspectives as well as the innovative approach and activities in the learning process (Navarrete, 2013); and (3) it's necessary to figure out the determinants and their relationships to enhance students' learning motivation and performance comprehensively . It would be helpful to the application and adjustment

direction of schools and teachers in teaching methods (Pileggi & O'Neill, 2008; De Freitas & Oliver, 2005).

Activity Theory

The Activity Theory was proposed by Leont'ev in 1978 which provide a framework for human learning behavior (Nardi, 1996). Based on Leont'ev's framework, Engeström (1999) extended its model to consider the situation, and added community, rules, division of labor to the structure. These six items are the elements of the activity system and are transmitted to the academic research fields in Europe and the United States. They become the main form of activity theory nowadays and are widely used in a variety of disciplines such as anthropology, education, and literature. Isssroff and Scanlon (2002) pointed out that activity theory could be applied to the use of technology in higher education. Kuutti also said that the integrated structure of activity theory enables its research to explore different levels of issues, which help to consider interactions in social contexts, while the practice in the context of the research is dynamic and developmental and is able to adapt to its changes and development. (Isssroff & Scanlon, 2002) Table 1. organizes the activity theory in foreign countries which related to teaching issues in recent years.

Table 1. Relevant Literature of Activity Theory in Educate Issues

Issues	Research content	Source
Learning method	Case Study, Massive Open Online Course (MOOC), Mobile Game-based Learning, Clinical Learning, Online Learning, Mobile Learning, Team-based Learning, Problem-based Learning, Project-based learning	Craig (2017), Czerniewicz et al.(2017), Su (2017), Larsen et al. (2017), Westberry et al. (2015), Ajjawi et al.(2015), Barhoumi (2015), Park et al. (2013)
Learning outcome	Small groups, Question formulation strategy, mobile computer supported, collaborative learning system, ICT integration into teaching environment	Thanh Pham et al. (2015) Zurita et al. (2007) Scanlon et al. (2005)
Teaching content	Lesson Plans, Internship	Chizhik et al. (2018), Solomon et al.(2014)
School-based development	Extend learning of teachers and schools	Postholm (2015)

In this study, the research conceptual model is conducted with the activity theory proposed by Engeström (1999), the eight-step model proposed by Mwanza, and description of related elements of ICT integrated from Xing et al. (2015), Paraskeva et al. (2010), Pearson (2009), Liaw et al. (2007) (as shown in Table 2.)

Table 2. Eight-steps Model Summarizes the Activities of ICT into Innovative Teaching

Analysis steps and units	open-ended questions	components of the activity
Activity of interest	What sort of activity am I interested in?	The integration of higher education in ICT into innovative teaching activities
Objective of activity	Why is this activity taking place?	The advancement of information technology has changed the current teaching environment. The purpose is to understand the actual use of students in ICT integration into innovative teaching or learning.
Subjects in this activity	Who is involved in carrying out this activity?	In Student's point of view
Tools mediating the activity	By what means are the subjects carrying out this activity?	Various tangible and intangible innovative teaching mechanisms, such as: ICT, multimedia related, Web, situational simulation, cognitive tools, laboratory, distance teaching, digital learning, virtual laboratory, case analysis, team learning, imagination integration into teaching, audio-visual Seminars, interactive teaching, team-based learning (TBL), problem-solving-oriented learning (PBL), collaborative learning, experiential teaching mode, game-oriented learning (GBL), computer-supported cooperative learning (CSCL), etc.
Rules and regulations	Are there any cultural norms, rules or regulations governing the performance of this activity?	School's policy, vision at ICT School resources, infrastructure and standards
Division of	Who is responsible for what,	School ICT support and support for innovative teaching courses

Analysis steps and units	open-ended questions	components of the activity
labor	when carrying out this activity and how are the roles organized?	The roles, functions, and tasks that teachers play in activities The tasks students should perform during the activity
Community	What is the environment in which this activity is carried out?	School units, teachers and students have a variety of channels for interaction and communication between teaching and learning communities。
Outcome	What is the desired Outcome from carrying out this activity?	Students' actual use of innovative teaching and satisfaction with the perception of ICT innovative teaching

Readiness

User Readiness: According to scholars (Liljander et al., 2006), user readiness is a state of mind that tends to bring users closer to using new technologies, and suggesting success in the self-service technology cooperation production, customers need to be equipped with three conditions: (1) Role clarity: the user knows what he wants and should do while using; (2) Ability (capability): The user has sufficient knowledge and skills in the course of use; (3) Motivation (motivation): Users know what benefits self-service technology brings, including intrinsic motivation and extrinsic motivation. Therefore, new technology products or services will be used only when the conditions of the three are positive. Past research has also pointed out that users in the process will be affected by the lack of understanding of their role to influence the use of innovation (Mills & Morris, 1986); however, in the ICT integration of innovative teaching, teachers and students should clearly understand themselves the role, as well as what you want and should do, and the willingness of teachers to practice new teaching methods are very important factors for improving education.

Information-based Readiness: The readiness of information developed to measure potential users. According to Hussein et al. (2009), potential users are interested in new technologies introduced by the market or recommended by participants. The results reflect the information capabilities of its potential users and determine whether to adopt or reject the innovation. In the past research, the information search behavior, acquisition and accumulation of knowledge are rarely discussed and linked to the user's decision on the adoption and acceptance of new technology. The information readiness consists of four facets, including: (1) Awareness: an individual knows the existence of an innovation itself and is interested in it (Rogers, 1995); (2) Knowledge: It indicates that individuals have the necessary information on how to use innovation correctly (Rogers, 1995); (3) Experience: It demonstrates the experience of individuals using related services and using computers in the past (Mattila et al. , 2003); (4) Exposure: It refers to the extent to which individuals are exposed to new technologies (Chang, 2003). Hussein et al. (2009) mentioned that knowledge can help users understand innovation and reduce uncertainty, thereby creating user motivation and allowing users to embrace innovation. Previous studies also indicated that users' past experience and new technology use have a significant positive relationship (Wang et al., 2003) and increase the compatibility of related services, thus increasing the willingness to adopt (Mattila et al., 2003).

ICT Support: ICTs nowadays are integrated into the campus environment and continued to expand their scope. The school's ICT support plays an important role for the organization in its integration process (Tezci, 2011). In the process of using IT in education, scholar Fu (2013) found in the past relevant literature that teachers, students and schools are the three important aspects of the successful implementation of ICT integration teaching. Therefore, school institutions should provide a standard working environment to help users gain the skills and confidence to use computers, and support the innovative and adventurous approach. However, in addition to the development of an innovative teaching environment might rely on the will of both educators and students , but the policies, mechanisms, and general practices of schools could also affect the process of teaching and learning. Furthermore, the school provides an important area for encouraging and supporting the use of ICTs to integrate into the teaching culture (Lai & Pratt, 2004), while technical support will affect users' adoption of innovative teaching (Fu, 2013; Yildirim, 2007). Therefore, providing sufficient technical support for teachers is also a very important factor (Tondeur et al., 2008); relative to the student's

point of view, lower technical skills will also reduce the application of ICT in the classroom, and the foundation of the school. Equipment and administrative support also reduce barriers to use and increase effective learning factors (Fu, 2013).

Satisfaction: Because ICT has made more choices and changes in today's teaching environment, some scholars believe that successful ICT integration into teaching depends not only on technical access and usability but also on user acceptance and adoption (Pajo & Wallace, 2007). Perceived satisfaction is one of the important indicators for determining the success of an information system (McGill & Hobbs, 2008) In addition, past studies have pointed out that the factors that are successfully adopted are continuous use and not just for the first time (Lin, 2012). Therefore, this study explores the factors affecting the use of communication technology for innovative teaching, including measuring the actual acceptance and satisfaction of users after adoption.

Methodology

In this section, we develop the hypotheses based on the previous review and propose a theoretical research model, then, illustrate the methodology on data collection and analysis.

Research Model

The following hypotheses explore the adoption in ICT integrated innovative teaching, and combine the readiness as construct to investigate the impacts of the actual use of ICT integrated innovative teaching and satisfaction. Hence, the hypotheses are illustrated as followings and presented in Figure 1.:

1. Information-based readiness and user readiness

If people have knowledge of an innovative technology, they can increase the motivation and intention of users to accept innovation (Hussein et al., 2009); user's information-based readiness will also affect the use of communication innovation products and/or the propensity of services (Rogers, 1995). Therefore, when users can collect more information about communication innovation products and/or services, they will be able to understand the benefits and usage of the innovative products and services of the communication. Hence, it is hypothesized that:

> *H₁: Student's information-based readiness has a positive effect on user's readiness.*

2. Information-based readiness and the actual use of ICT integrated innovative teaching

The information base readiness mainly understands the behavior of user information collection. The higher the user's information base readiness, the user has the collected information. Relevant conditions are also prepared for the collection of relevant information (Hussein et al., 2009). Many scholars also pointed out that the more information disclosure and past experience will have a positive effect to determine whether the new technology is adopted or not (Hussein et al., 2009; Wang et al., 2003). Therefore, this study measures the readiness for collecting information. Hence, it is hypothesized that:

> *H₂: Student's information-based readiness has a positive effect on the actual ICT use.*

3. User readiness and the actual use of ICT integrated innovative teaching

User readiness, as described in the previous section, includes three factors, including ability, motivation, and role clarity, to determine whether the user has decided to adopt innovative products and/or services (Bitner et al., 2002). To decide the adoption of ICT integrated innovative teaching, students should clearly understand their roles and positioning, including what they want to do and what they should practice. Relevant research also points out that the adoption of technology will be affected by the user's skills and capacity (Hoffman & Novak, 1996). Therefore, when the user's readiness is higher, the more sufficient conditions are available to incorporate the communication into the innovative teaching method. This study measures user readiness to understand whether students are ready to the actual use of ICT integrated innovative teaching. Hence, it is hypothesized that:

> *H₃: User readiness has a positive effect on the actual ICT use.*

4. ICT support from school and the actual use of ICT integrated innovative teaching

After evaluate and determine the effectiveness of the readiness, scholars have agreed that schools are a field that encourages and supports the use of ICT integrated instructional culture (Lai & Pratt, 2004), and the technical support of schools affects the use of innovative teaching by users (Fu, 2013; Yildirim, 2007). Therefore, the school must play the role of assisting educators and learners in technical tools and policies, and provide an environment that supports the institution in order to continuously pursue the creative and innovative teaching environment (Fu, 2013; Ferrari et al., 2009). Therefore, this study measures the school's ICT support to confirm the effect to the actual use of ICT integrated innovative teaching. Hence, it is hypothesized that:

> ***H₄: ICT support from school has a positive effect on the actual ICT use.***

5. The actual use of ICT integrated innovative teaching and satisfaction

In order to achieve the desired results in the ICT integrated innovative course, it is sure to consider learners as the center (Fu, 2013; Tezci, 2011). Therefore, to measure the success of ICT integrated innovative teaching, in addition to the teacher's considerations, students should also be considered (McGill & Hobbs, 2008). Scholars also believed that the successful integration of ICT into teaching depends not only on the acquisition and availability of technology, but also on the acceptance and adoption of teachers (Pajo & Wallace, 2007), which also affects the learning methods and the use situation of students in the classroom. And the real success factor is that users can use it continuously (Lin, 2012). Therefore, this study believes that the degree of perceived satisfaction of students should also be considered after their actual adoption as a feedback mechanism from the innovation decision process to the adoption. Moreover, satisfaction is one of the important indicators for users to determine the success of an information system (McGill & Hobbs, 2008). Therefore, this study refers to the activity theory framework and classifies the satisfaction as the outcome after the use of ICT integrated education. Hence, it is hypothesized that:

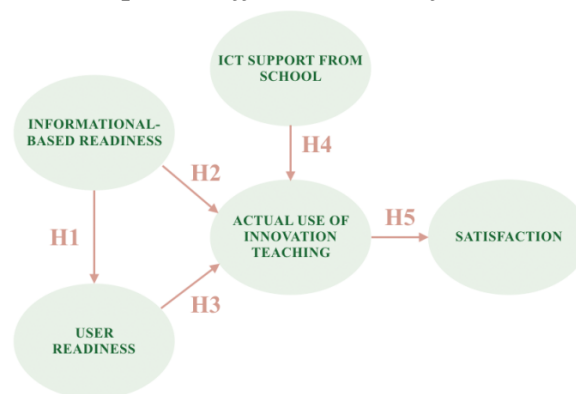> ***H₅: The actual ICT use has a positive effect on the satisfaction.***

Figure 1. Research Model

Data Collection and Analysis

This study explores the related activities of the ICT involved in the innovative teaching based on the activity theory, and explores the learning tools, rules, community and division of labor used by students who use ICT integrated innovative teaching. The questionnaire was designed in two parts. First, aim to this study's purpose, we referred to Xing et al. (2015), Paraskeva et al. (2010), Pearson (2009), and Liaw et al. (2007) description and developed 9 measurements including teaching methods (tool), school basic equipment (rule), learning resources (rule), vision and policy (rule), community (community), learning environment (division of labor), and school ICT support (division of labor) due to the 6 elements from activity theory, to confirm whether there is a practical use of ICT integrated teaching adoption with student perspective to screen the respondents for further analysis. Second, the variables of conceptual model include information-based readiness, user readiness, ICT support, actual ICT use, and satisfaction. In information-based readiness, Hussein et al. (2009) defines the four constructs which are experience, knowledge, awareness, and exposure for totaling 19 questions, including the experience and knowledge on computer, Internet, and ICT integrated learning . In user readiness, Bitner et al. (2002) proposed three constructs which are role clarity, ability, and motivation

for totaling 21 questions, including knowing and have capability on how to use ICT integrated learning with confidence and clear expectation. In ICT support from school construct, this study defines the ICT support from school as the technical and information support from school during the ICT integrated and develops 7 questions. In actual ICT use construct, refers to Liao and Lu (2008), Hernandez et al. (2011) questionnaires to measure the degree of actual ICT use with 4 questions. In satisfaction construct, this study defines students' perceived satisfaction as the satisfaction of knowledge acquisition, experience, sharing in ICT integrated education and develops 8 relevant questions. The questionnaires were distributed in 100 Taiwan universities and uses the Likert seven-point scale to quantify the scores filled by the respondents. For analysis, the descriptive statistics are analyzed by SPSS for Windows version 21 and the confirmatory factor analysis and overall structure are used AMOS version 21 for structure equation modelling analysis. For the first stage, evaluated the effectiveness of measurement model, including reliability, convergent validity and discrimination validity. After the measurement model reaches the adaption level, the second stage of overall structural model was processed.

Findings and Discussion

An empirical survey was conducted during June to October 2018 and a total of 603 questionnaires were collected through hard copy and online distribution. In order to control the sampling consistency, the online version is for the student who is absent while we distributed the hard copy. Total 133 questionnaires with missing data and incompatible answers were excluded (response rate 78%). The remaining 404 questionnaires were used in the statistical analysis.

Descriptive Statistics Analysis

An overview of the respondents' profile as derived from their demographic information in the questionnaire including gender: male (43.3%) and female (56.7%); age: under 17 (0.5%), 18~21 (76.5%), 22~25 (20.0%), 26~29 (2.7%), and over 29 (0.2%); school: public school (21.5%) and private school (78.5%); grade: college (0.7%), freshman (16.3%), sophomore (10.6%), junior (51%), senior (10.4%), graduate (10.9%).

Based on the activity theory elements, this study develops 9 measurements including teaching methods (tool), school basic equipment (rule), learning resources (rule), vision and policy (rule), community (community), learning environment (division of labor), and school ICT support (di-vision of labor), then clusters public/private school students, male or female students, different grades students for cross analysis. This study discusses the cross analysis for public and private school students. The highest three teaching methods used are case study (50.2%), computer aided instruction (44.3%), and e-learning (42.8%). Most of the teaching methods have been used to private school students more than public school students. In schools' vision and policy to ICT integrated questions received low support rate (25.7%~39.6%) which means neither public or private school students think that their schools have good vision and policies to promote ICT integrated education. In basic equipment questions, students agree that school provides enough hardware for integrating in ICT related courses (73.3%), but the integration of hardware and software (60.3%) and the sharing of equipment (52.9%) could be improved. Most of learning environment answers do not distinguish the differences between public and private school; however, the last question of this part which asks "I will response to the teacher and complete the assignments." has an obvious gap between public school students (52.9%) and private school students (39.2%). In community results, private school students form more types of communities than public school students, such as the community with professor for research purpose, and the chatting or information sharing groups with peers. The widely use of learning resources in ICT integrated education are school's website and app (77.7%) and the online resources from library (62.1%). There is an obvious difference on the computer network classroom which private school students (66.9%) use much more than public school students (26.4%). In ICT support measurement, the responses show that the public school students have better technical support from their schools that private school students. Since these results may have different findings on different clusters, we then did the other cross analysis for learning resources with grade, and community with gender. The results show that the learning resources which related to the library no

matter the online resources or information literacy courses used growing with grade. And most of learning resources are used by freshman and senior students. In community construct, while we do the cross analysis for male and female students, all the answers show that female students join in more and different type of groups than male students.

In this study, the statistical analysis of each variable was carried out, and each facet was measured by the Likert's seven-scale. The score was 7 points from "very agree" to "very disagree" as 1 point, and describe each construct in average and standard deviation. The high average (5.49~6.19) and low standard deviation (1.06~1.16) of experience shows that the net generation is familiar with ICT, since the ICT tools exist in their daily lives. In knowledge, KNG_6, which is "I will discuss the possibility of ICT integrated education with others." got the lowest average (3.90) in all questions. In awareness, AWR_12, which is "I am interested in using ICT integrated education method." got higher average (4.43) than other awareness questions. In exposure, EPO_14, which is "I have used ICT integrated innovative learning." got higher average (4.51) than other exposure questions. Each of role clarity question got about 4 points in average means half of students are not clearly understand their role in ICT integrated education. In actual use construct, ACT_3, which is "I usually use ICT tools for innovative learning." got lower average (4.30) and had the highest standard deviation (1.40). The students may have been used ICT integrated education, but the continuous usage could be the reason for this situation. Students believe that ICT integrated innovative teaching can let the knowledge sharing more effective, since the SAT_6 got the highest average in the satisfaction construct (4.87).

Reliability and Validity

In order to check reliability and validity of questionnaire's measure, different sets of test were required to be done. Cronbach's α and composite reliability test were used to the internal consistency. All the Cronbach's α values (.86~.97) exceed 0.7 which reflected the variables in each construct are highly relevant.

The model analysis results are divided into two parts, including model adaptation degree and convergent validity, and discriminant validity. Among them, the convergent validity is used to measure the observation variables of the same construct to confirm whether they are highly correlated with each other; and in the standard value of the evaluation measurement model, the standardization residual value is too high or factor measurements with too low a load should be deleted, and the standard factor load (SFL) value after normalization is retained above 0.45. Finally, remains 43 questions for constructs' confirmatory factor analysis, and each question reach significant level (P<.05). Convergent validity was evaluated using Average Variance Extracted(AVE). All the AVE values exceeded the threshold of 0.5 which reflected reasonable values.

The discriminant validity is that the degree of correlation between the items of different facets should be low. The square root of the AVE value of each construct correlation coefficient matrix is between 0.73 and 0.85, and the total number is greater than the correlation coefficient between the constructs. The analysis results meet the criterion; therefore, the research scale has discriminant validity. After the above model-related appraisal, the internal and external quality of the model is consistent suitable for structural model analysis for the next phase to verify the causal relationship between potential variables.

Hypothesis Testing

In order to test hypotheses, path coefficients, *p*-values and *t*-statistics (results of AMOS) were examined. AMOS-SEM was used to determine the effect of variables. The results show this model to be structurally good, since the user readiness (R^2=0.88), actual ICT use (R^2=0.68), and satisfaction (R^2=0.81). SEM model fit are also good (χ^2/df= 2.97). Table 3. summarizes the results for hypothesis testing.

Table 3. Summary results (*, *p*<.001)**

	Path	Path coefficient (*t*-statistic)	Result
H₁	Information-based Readiness -> User Readiness	0.94 (25.96)***	Supported

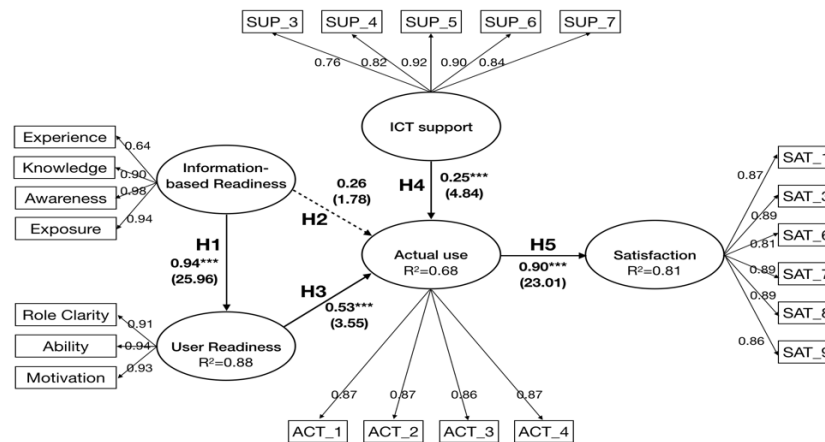|			
H_2	Information-based Readiness -> Actual use	0.26 (1.78)	Not supported
H_3	User Readiness -> Actual use	0.53 (3.55)***	Supported
H_4	ICT support -> Actual use	0.25 (4.84)***	Supported
H_5	Actual use -> Satisfaction	0.90 (23.01)***	Supported

Figure 2. Confirmed Conceptual Model

The empirical results are "information-based readiness" will directly affect "user readiness", the explanatory variance is 88%; "user readiness" and "school ICT support" will also directly affect the "actual ICT use" of ICT integrated education, and the explanatory variance is 68%; and "actual ICT used" also directly affects students' learning "satisfaction", which accounts for 81% of the variation. Therefore, the results of this study show that, except for H2, the other four hypotheses are significant.

The "experience" factor load (0.64) is the lowest. However, previous research shows the user's past experience and new technology use has significantly positive relationship (Wang et al., 2003). Exploring the reasons may be different for today's 21st century net generation and previous students' ideas and learning backgrounds. New generation of young people can gain faster access to emerging technologies and environment, and the tools such as computers, internet and multimedia platforms are fully integrated into their lives. In addition to experience, in the information-based readiness, the "awareness" factor load is the highest (0.98), and the "exposure" (0.94) and the "knowledge" (0.90) are also quite high, indicating that those sub-surfaces can help students understand the integration of ICTs into innovative teaching and reduce uncertainty to enable ICTs incorporating innovative learning approaches reduce barriers to adoption (Hussein et al., 2009). Chang and Thorson (2004) pointed out that the exposure of new technology information plays an important role in the adoption decision-making of ICT integrated innovative teaching. This study confirms that students' information-based readiness for ICT integrated innovative teaching has a positive significant impact on user readiness (H1). This result verifies that people who have knowledge of an innovative technology will raises the users' (students) acceptance to the motivation and intention of innovation, which in turn affects the user readiness proposed by Bitner et al. (2002).

The result of H2 has no significant positive impact relationship, that is, no direct impact effect. Exploring the reasons, the 21st century net generation students have ICT integrated into their lives all the time, and has sufficient belief and strong computer self-efficacy. Therefore, it is better to use ICT and other tools in a more positive attitude than to use ICT to integrate into teaching (So et al., 2012), and So et al. (2012) also pointed out that the past experience of ICT of net generation students does not directly affect the use of innovative ICT tools in the future, but it will be indirectly affected by computer self-efficacy, which also confirms the information-based readiness indirectly affecting the actual ICT use in innovative teaching through user readiness.

The user's readiness three sub-surfaces are sufficient to measure the effects with ICT integrated innovative teaching. Among them, the "ability" (0.94) factor load is the highest, and then "motivation" (0.93) and "role clarity" (0.91). The ability and confidence of students themselves can influence the adoption of ICT (Hoffman & Novak, 1996). Student's user readiness will positively affect the actual ICT use in innovative teaching (H3) which confirms the influence of using ICT

integrated because of they understand their roles (Mills & Morris, 1986), and clearly know what they want and should do; and the students will have skills, confidence and abilities (Hoffman & Noak, 1996), and attitudes and beliefs (Valtonen et al., 2009). Perhaps the students' information-based readiness of ICT integrated innovative teaching is not enough, but it will positively influence the learners' own abilities and motivations, and thus affect the actual ICT use in innovative teaching. The study also pointed out that it is challenging to maintain students' IT-related learning. Therefore, how to promote students' ability to enhance their learning and motivation in the practice of ICT integrated innovative teaching, not only pay attention to students' engagement is particularly important (Henrie et al., 2015).

The hypothesis of ICT support from school and the actual ICT use in innovative teaching (H_4) is positive and has a significant impact of implementation phase. School plays the role to encourage and support the use of ICT in teaching (Lai & Pratt, 2004), this study also verifies that school technical support will affect students' adoption of innovative teaching (Fu, 2013; Yildirim, 2007), and the school is an important role in assisting educators and learners in technical tools and policies. Therefore, this result confirms to provide an environment that supports schools to promote ICT integrated innovative teaching can continue to pursue creativity and innovative teaching (Fu, 2013; Ferrari et al., 2009).

The actual ICT use in innovative teaching has a positive and significant impact on the student's perception of satisfaction (H_5). The results could be used as adjustments and references for further research in the process of adopting ICT integrated innovative teaching. Therefore, the current ICT integrated innovative teaching practices are considered in learner center to achieve results (Fu, 2013; Tezci, 2011), so in addition to the teachers' teaching methods, students' perception should also be considered (McGill & Hobbs, 2008). This result supports that ICT integrated in higher education not only affects the students' learning methods and learning situation in the classroom, but also affects their continued use intention.

Conclusion

In this study, the context about ICT integrated education was explored and the relationship among determinants was examed from the proposed research model. However, some research limitations are found and will become the future work to involve.

Implications

ICT is a diverse range of technology tools, communication and creative resources, communication, storage and management information. It has the potential to expand the power of education opportunities (Sang et al., 2010). In addition to knowledge teaching, talent training and potential development in higher education, it also covers innovative technologies and knowledge transfer and transformation. The rapid development of the ICT has promoted the change of knowledge forms, the richness and diverse appearances of knowledge expression, transmission and transformation methods, and the innovation and flipping of various educational methods. Therefore, this study explores the subject, tools, rules, community, division of labor, and object of the activity theory elements involved in ICT integrated education.

This study discovers that students' roles, abilities, and motivations directly affect their actual use of ICT integrated innovative teaching with learners' perspective which helps compensate for previous studies. Students' information-based readiness are indirectly affecting the actual ICT use through the user readiness, but they have no direct impact. Actually, the ICT's relevant experience of the 21st century is no lack of and different from the growth background of previous students. But the results also show that the student's own experience, knowledge, awareness and exposure will directly influence the student's own user readiness including role clarity, ability and motivation, indicating that the more students understand and how to use these ICT-related tools, the higher of their ability and motivation, the higher the degree of actual ICT use in innovative teaching.

Besides the tangible and intangible tools of ICT, the school's ICT policy, infrastructure, learning resource, and the learning environment between teachers, students, and schools should also be open and communicated, which should be valued and considered by the school. The study shows that the more widely and effectively promoted the innovation of the school and the integration of teaching in ICT, the more the overall development can be progressed, while the students' satisfaction with learning is relatively high. The results of this study also confirm that the ICT support from school will positively affect the students' actual ICT use in innovative teaching. Moreover, the actual ICT use will further positively affect students' learning satisfaction. The more diverse or frequent the process, the higher the satisfaction with learning. It is undoubted that one of the tools proves that ICT is indispensable for students in the learning process. And it can be advocated by today's schools and teaching institutions, then become the direction for the school and related educational institutions to continue their efforts and deeper implementation. In practical, the proposed research framework could also become the basis for evaluating the ICT integrated education performance.

Limitations and Future Work

Since the study explores the practical application of ICT integrated innovative teaching from the learners' perspective, it is also necessary to be observed from the teachers' perspective in order to understanding whether there are differences between teachers and students in the understanding of ICT integration teaching and learning. Teachers nowadays are not the 21st century net generation, they should also consider whether teachers are now ready to promote diversified teaching models in today's colleges and universities. Therefore, to collect and compare the perspective from teacher is our focus on future work. Because this study uses the cross-sectional data, the influence of the independent variable upon the dependent variable is only measured at a certain time point. Therefore, further research should conduct long-term observations and comparisons on learning changes to gain a deeper understanding of student learning changes. After all, the discussion on the ICT integrated innovative teaching is still in development, and it takes more time and effort to explore it.

There may be self-selection bias during the questionnaire sampling, which may have a certain degree of impact on the results of this study. This study uses convenient sampling on students, but in fact the development and resources of their schools are not the same and are not limited by the number of samples, so that the research and theoretical models are still limited by generalization and extrapolation. Therefore, it is only possible to separate the public and private school students to observe relevant information, and the future research directions can be com-pared and observed in groups. This study explores from the students' perspective, but it does not consider the other factors such as the degree of involvement of individuals in the learning process. Therefore, the further study may add more relevant variables, including the student's family background, the characteristics of the students themselves, teaching subjects and content, etc. to explore the relevance of their ICT integrated innovative teaching topics in the future.

Acknowledgements

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