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This research demonstrates the design of Joyful Mobile Navigation Systems (JMNS), which consists of joyful, mobile, flexible and ubiquitous features. The Technology Acceptance Model (TAM) and Integrating Learning Models (ILM) were used to design the teaching activities of Flow Learning and Inquiry-Based Learning in order to enhance learning motivation and interests for students in the ecological teaching activity. The developed JMNS belongs to a personalized informatin station of KIOSK that contains RFID bar-code recognization, tag reader, input device, mobile computation unit, QR-code, mobile display device, wireless local network and operating software. The aim of this research is to design and analyze the JMNS's characteristics of the external variables, reliability and validity by measuring through the Human-Computer interface, which is achieved through the Questionnaire for User Interface Satisfaction (QUIS) and implemented by using QR Code, GPS and RFID technologies. The developed JMNS have been applied in real teaching activity for improving learning intention. The research results show that the designed JMNS and teaching activity have a positive significant impact on learning motivation, material characteristics, perceived usefulness, perceived ease of use, attitude to use, and behavioral intention. The results also show that only significant of part with support for the students' system characteristics to the perceived usefulness, and perceived ease of use. That is, system developers should improve the design of Context Awareness System of teaching to help students in mobile navigation and teaching activity to have a comfortable interaction and increased learning intention. Furthermore, using JMNS in teaching activity can simultaneously increase learners' motivation and offer a more joyful perception to learners during the learning process.

Keywords: inquiry-based learning (IBL), flow learning (FL), mobile learning (ML), ILM, JMNS, TAM, QUIS.

INTRODUCTION

The invention of high-tech products such as mobile phone and PDA have changed the ways of people's communication and learning. The research institutes of Topology industry (2011) predict that productions of global intelligence mobile phone reach 33.8%. Also, Asia area account for 27.8% of global mobile phone productions and become the largest area in 2011 as shown in Figure 1.

The growth by a wide margin of number of times about searching the key word of " Mobile Learning " from 2004 to 2011 by statistics of Google Trends as shown in Figure 2.

The above data showed development of high-tech products change the users' communication and learning

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State of the literature

- Current research offers a large number of references about students' mobile learning in various technology education topics.
- Current research offers assumptions, conecpts, and approaches on how to improve students' learning intention in various technology education topics but has rarely assessed and verified in detail how theory works on the acceptability of systems.
- Typically, research concentrates on an independent topic or whatever skills applied on mobile navigation and teaching activities for describing learning models and approaches towards enhancing learning motivation and interests. Thus, an integrating of way to other independent models is often not straight forward.

Contribution of this paper to the literature

- The paper offers ways to design the teaching activities of Flow Learning and Inquiry-Based Learning on mobile navigation to improve learning motivation and interests for students by using TAM and integrating learning models.
- The paper is to analyze the Joyful Mobile Navigation Systems' (JMNS's) characteristics of the external variables, reliability and validity by measuring through the Human-Computer interface, which is achieved through the Questionnaire for User Interface Satisfaction (QUIS) and implemented by using QR Code, GPS and RFID technologies.
- Results shown that the designed JMNS and teaching activity have a positive significant impact on learning motivation, material characteristics, perceived usefulness, perceived ease of use, attitude to use, and behavioral intention.
- Using JMNS in teaching activity can increase learners' motivation and offer a more joyful perception to learners during the learning process.

(Wang, 2012). And it became the indispensable learning tool for students' university life in the the future campus. Corlett (2005) pointed out familarizing holding-type device had applied on university digital courses. With the concept of "Mobile-Learning Organizer", exactly integrate individualized system including course information, studying record, and transcript notic etc. Students know the latest course trends through the mobile device at any time.

The convenience and effectiveness of using mobile devices in learning and teaching activities has seized the great attention of educators around the globe (Uzunboylu, Cavus, & Ercag, 2009). Mobile devices and wireless Internet technology enable learners to learn by

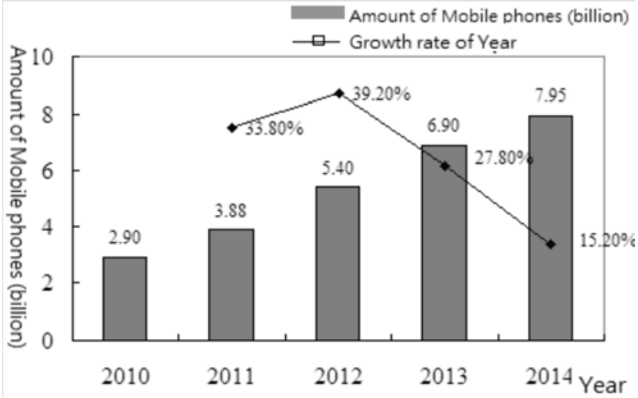

Figure 1. *Amount of mobile phones vs. Growth rate of year during 2010~2014*

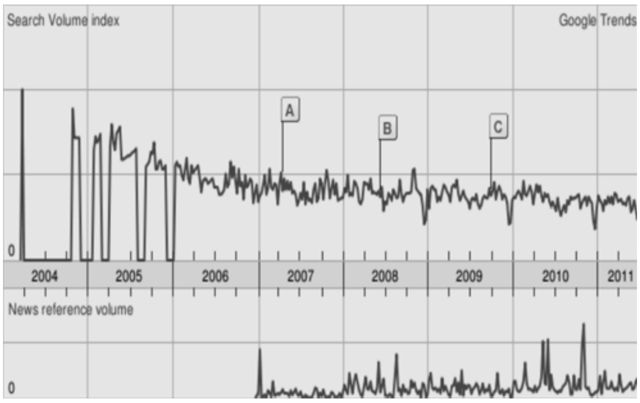

Figure 2. The searching trend of "mobile learning"
A-*Nigeria: BSNN Commences Action Learning in Abuja AllAfrica.com (2007)*
B-*Diving Head-First into Action Learning BusinessWeek (2008)*
C-*Action Learning to Build Skills and Contribute to the Bottom LineHuffington Post (2009)*

using a variety of digital resources from anywhere in the world at anytime (Hsieh, Jang, Hwang, & Chen, 2011).

Joy is described as a vivid feeling or emotion of pleasure defined by the Oxfor English dictionary. In this research, we name the "joyful" as a certain kind of learning process or experience which could let learners feel pleasure during the learning process. Many modern educational activities with joyful learning features are being developed and a joyful perception is found to have positive influence on the motivation of learning (Chen, Chen, & Liu, 2010; Kirikkaya, Iseri, & Vurkaya, 2010).

This research assessed the effect of learning process related to the teaching style which learners received and also their learning styles (i.e., Flow Learning and Inquiry-Based Learning). This research was conducted with the suppostion that students receiving JMNS which increased their learning motivation would perform better in their learning intention. A u-learning environment was also established for an ecological course for conducting experiences in this research.

LITERATURE REVIEW

Inquiry-Based Learning

Inquiry-Based Learning (IBL) focuses on the inquiry activities of knowledge for students as the major teaching tactics. Teachers asked questions and offered materials related to teaching theme during teaching process. Students can carry on inquiry activities voluntarily. Lin & Hsipeng (2000) designed navigation activity according to IBL theory. Providing clues takes for the guidance of IBL during inquiry process. Learners can enhance their learning motivation and interest by way of inquiring and interacting with objects in games.

Anderson (2002) instructed inquiry has a decades-long and persistent history as the central word used to characterize good science teaching and learning. Professional development is based in inquiry as a way to build scientific knowledge. Within inquiry, we focus on the nature of scientific communication emphasizing rhetorical stances, text structures, genres, and patterns of argumentation reflected by a modernist view (Baker, Lewis, Purzer, Beard, Bueno-Watts, Perkins, Uysal & Wong, 2009). Gautreau & Binns (2012) stressed inquiry and place-based education. Environmental Education (EE) has dual purposes as a teaching method and a learning goal. The learning goals of EE fall into two categories, content knowledge and behavioral change.

Furthermore, Varma, Husic, & Linn (2008) stated most teachers understand the benefits of inquiry curricula and have interest in using new technologies to support their inquiry teaching but resist using these approaches without appropriate support. Therefore, technology enhanced learning in science modules can increase the effectiveness of inquiry learning. The designs of teaching activity for Inquiry-Based Learning are described in Table 1.

Flow Learning

Cornell (1998) proposed the way of flow learning and regarded students as the main target. Attracting students' interest to the teaching activity first, and then further leading students to strengthen their sensitivity of environment, and experiencing the ambient environment directly. Finally, students share and study their gains and experience one another. The designs of teaching activity for Flow Learning are described in Table 2.

Table 1. Design of teaching activity for Inquiry-Based Learning

Element	Explanation	Purpose	Activities
Inquire	Explain related rules of mobile navigation teaching system.	Find out the intension of mobile learning and the method of devices.	To explain the teaching of PDA navigation
Investigation	Start to explore according to the clue of navigation.	Lead students to learn.	Design teaching activity to put forward the question and explore.
Construction	Find out the plant site, describe, study and observe in detail according to the topic.	Observe and find out the position of plant in detail.	Look for the ecological navigation site and observe plants.
Discussion	Share and investigate the experience. Find out the meaning of investigation.	Discuss the answer to the question.	Discuss and interact in the group.
Introspection	Utilizing PDA to study the ecological teaching navigation. Learners proceed their own evaluation. To confirm the effect of studying.	Answer the question and review.	Answer the question and commenting amount oneself.

Table 2. Design of teaching activity for Flow Learning

Element	Explanation	Purpose	Activities
Arouse enthusiasm	Let everybody become interested and sensitive, show the natural feeling.	Stimulate interest and sensitivity.	Application of field trial activity.
Focus attention	Let students attention-focusing and ability to absorb.	Initiate curiosity and increase attention.	Explain the content of plant.
Direct experience	Let students experience and appreciate natural world essence to expand students' esthesia field directly.	Absorb and absorb again, train curiosity and input.	The experience of feeling includes voice, touch, wind blow, fetch the food, nest, hide, taste, sense touch, color and luster.
Share enlightenment	To offer the experience of studying to oneself. To exchange the gains each other and share the idea.	Strengthen the experience that obtaining from activity.	DIY creates including seed craft and rubbing, etc., Taking pictures and sharing the works.

Instruction and Learning perspectives

There are two main perspectives included in this research which namely learning and instruction. From the learning perspective, learners' attitudes and intentions are very important and could be cultivated through adopting appropriate pedagogies in learning process. Therefore, while designing the JMNS, the goal is to cultivate and increase learners' intentions to study (Tsai, Chen, & Chen, 2010).

From the instruction perspective, if instructors simply use oral lectures without any supplementary tools to explain learning materials, learners are not apt to comprehend the meaning and lack of learning interest. Thus, instructors can use physical objects or tangible tools for providing learning help. For example, instructors could utilize mobile devices to enhance learners' intentions to learn. Particularly, learners are trying to acquire instant help for absorbing knowledge. It is difficult in conventional learning environments without any information and communication technology (ICT) support. The ICT advancements have made technology enhanced learning (Chen, Lin, & Kinshuk, 2008) and mobile learning (Huang, Kuo, Lin, & Cheng, 2008) more and more popular in our educational setting.

Mobile Learning

Rogers et al. (2005) regard mobile learning as learners try to study by using high-tech device. Also, learners can study anywhere, not restricted by time and place due to the convenience and mobilization of mobile devices. Lehner et al. (2002) proposed mobile learning is a pervasive and persistent setting which allows learners to access learning materials accessably, flexibly, and seamlessly, in any places at any time, both from the physical environment and from the Internet.

The rapid development of wireless networking technology and mobile technology has given rise to the emergence of u-learning environments. The u-learning environment can thus host learning activities which are knowledge-centered, assessment-centered, student-centered, and community-centered (Hwang, Shi, & Chu, 2010).

A lot of learning activities have been implemented in such a u-learning environment. For instance, Liaw, Hatala, and Huang (2010) developed learners' knowledge management system with PDA to enhance learners' satisfaction and encourage their autonomy. Huang et al. (2010) designed a mobile plant learning system to facilitate student learning in an elementary-school-level botany course. In this research, trying to design a joyful mobile navigation system by integrating Inquiry-Based and Flow learning models applied on ecological teaching activity to increase learning motivation, learning interest, and learning interaction so as to assess the intention of adopting mobile technology learning by learners.

Design and Implementation of Joyful Mobile Navigation Systems (JMNS)

The aim of research is to design and assess the mobile navigation with JMNS by using RFID, QR Code, and GPS technologies. The designed navigation systems can be used in different learning perceptions applied in one day of learning trip on campus with PDA/Smart phone navigation, with the collaborative learning of mobile devices and tangible field to conduct creative environment and to enhance more learning intention and Human-Computer Interaction (HCI). The perceptions of systemic application are shown in Figure 3((1)~(3).

The JMNS offer joyful, mobile, flexible and ubiquitous features and services belong to a personalized information station called KIOSK (Figure 4a, 4b) in this research has designed a prototype to support students' learning in ecological teaching activity. The JMNS's interface is devised and implemented by using high-tech products which have a tangible body with several smart functions that are useful in the learning process. Also, JMNS could bring joyful perceptions to learners.

RFID, QR Code and GPS techniques applied on mobile navigation and teaching activity

The progress of high-tech devices becomes more and more popular. There have already been some

(1) PDA/Smart phone trip (2) GPS navigation (3) DIY Field trial learning

Figure 3. The three perceptions of systemic navigation with mobile devices

Figure 4a. KIOSK station

Figure 4b. KIOSK station

Table 3. Related research for QR Code, GPS, and RFID techniques applied on mobile teaching navigation

Research Abstract	Target	Technique	Applied Field
Visitors use cellphone to connect with systems for visiting and exploring by the QR Code mobile navigation system.	tourist	QR Code	temple
Utilize QR Code and E-portfolio to analyze users' progress and effect.	student	QR Code	culture reservation
Mainly probe the dynamic multimedia and combine the mobile bar code to apply on the research of campus navigation.	college	QR Code	campus navigation
Using GPS's positioning database to produce mobile historical pavement navigation.	college	GPS	historic spot
To set up GPS environment and let learners to perceived in such a field land.	student	GPS	campus plant
Learners utilize the intelligent mobile phone and GPS to carry on understanding and studying insects.	elementary school	GPS	insect
Combine PDA and RFID to develop a set of 5E situation and perceive the system.	elementary school	RFID	fish explore
Use RFID and combine the concept of game theme to set up a learning system of museum.	tourist	RFID	museum
Build and construct the campus plant teaching guide system by taking PDA as device through RFID technology.	student	RFID	campus plant

innovative techniques applied on teaching activities. At present, some relevant researchs have applied on different teaching situations. To design a joyful mobile nevigation teaching activity in this research according to some literatures that adopting techniques of QR Code, RFID and GPS which applied on mobile teaching and learning activities. Briefly state as follows (Table 3).

Questionnaire for User Interface Satisfaction, QUIS

Questionnaire for user interface satisfaction (QUIS) proposed by Shneiderman, and improved by (Ghin, Diehl & Norman, 1988). QUIS uses the interdynamic human-computer point of view to evaluate the subjective satisfaction of users. QUIS possess the way of measuring with satisfactory reliability and validity. QUIS adopts 7-scale evaluation interface and contains five aspects of satisfaction included prototype, response, menu, interface choice of word, interface information, studying, and software efficiency.

According to some literatures, this research defined the systemic characteristic of mobile navigation and teaching activity as the measure indicators for the design of systemic interface, the interdynamic and transitivity of systems, and the display of checklist. The main effect is to discuss learners' substantial receptions of using information technlology for the operation and application of systems.

Technology Acceptance Model, TAM

Technology Acceptance Model (TAM) is used for assessing and predicting the acceptance that users adopt new information technology (IT) and realize the reasons whether users accept or refuse to use IT or not. Based on the Theory of Reasoned Action (TRA) Davis (1989) designed TAM to explain and predict behavior and intention when IT is used. TAM theory has become a hot topic recently in the field of informationi research. The proceedings of TAM theory models are shown in Figure 5.

Learning motivation

Keller & Litchfield (2002) pointed out motivation influences mankind's key element in learning technology. Small & Gluck (1994) mentioned the motivation is the important indicator that predicts individual's studying achievement and the demand for understanding motivation. To use the appropriate teaching tactics can increase students' learning motivation and improve the effect of teaching. Batra & Ray (1986) mentioned the inherent motivation has positive relationships in perceived usefulness and perceived ease to use of TAM.

Aslihan, Ercan & Yasar (2008) refered to Keller (1983) proposed Attention, Relevance, Confidence, and Satisfaction (ARCS) model contains the psychological motivation theory intergrated in the teaching activity design. That theory model is absolutely facilitate and helpful to students. IT is contributive to auxiliary teaching and improves the motivation of learning. Keller (1983) defined learning motivation to be the characteristic of teaching materials and was satisfied with the questionnaire interdynamically through the human-computer interface related to the attitude, behavioral intention, then to set up the structure of learning. Evaluating students' learning motivation for the mobile navigation teaching courses designed by ARCS in this research.

Ecological consciousness

To enhance learning motivation and interests for students, this research adopted the teaching activity of the ecological course. We see Ecological Consciousness as a meta-term, signifying "the human condition in which all daily behaviours are viewed through a lens of ecological literacy and responsibility such that these behaviours form an ecologically beneficial lifestyle" (Puk & Stibbards, 2010). The education system has a central role in encouraging the growth of ecological literacy. Puk (2012) stressed that traditional teaching has entered into a new learning environment where students are able to choose diversifying learning. Students can assimilate books knowledge into learning by way of participating the empirical learning and experience of outdoor activity such as plant ecological teaching in this research. The change of learning may also have implications for lifelong ecological literacy and provides direction towards the restructuring that schooling may require in order to influence global efforts to deal with ecological degradation.

METHODOLOGY

To design and analyze the JMNS's characteristics of the external variables, reliability and validity by measuring through the Human-Computer interface, which is achieved through the Questionnaire for User Interface Satisfaction (QUIS) and implemented by using QR Code, GPS and RFID technologies is the aim of this research.

The participants

The experiment was conducted at a national university in southern Taiwan. There are 50 students in the department of forest took the community and forestries course as the pre-test by target. The students were involved in taking mobile navigation and teaching activity of eclolgical course. The students were 17 years old on average.

The population in this research chose students at Technology University in Pingtung inclues departments of Forest, Veterinary medicine, Plant industry of Agriculture & Veterinary medicine College, and department of Management information systems of Management College. 167 of 206 questionnaires are collected as effective in this research; the effective rate of collecting is 81%. This research took ecological teaching navigatioin as an activity, the target of examining as the main sample with 78.4% in the Agricultural & Veterinary medicine College, counts 43 students in Forest department; 15 students in Veterinary medicine department, 73 students in the Plant industry department. There are another 36 students in Management College with the rates of 21.6%. In addition, the sample of population here takes university student as the core target. 124 students counted that testees are mostly students' samples of first one with 74.3%, grade four is 37 students with 22.2%, but other grades only accounted for about 3%. There are 92 boys account for 55.1% and 75 girls for 44.9% in this research.

Measuring tools

Pre- and post-tests were designed to evaluate the students' reflection levels of learning motivation, attitude, and intention to technology by using mobile navigation and teaching activity collocated with ecological course. The pre-test contained 59 questions that asked students about different constructs of 13 questions in Learning motivation, 8 questions in Material characterist, 11 questions in Systemic characterist, 6 questions in Perceived ease of use, 9 questions in Perceived usefulness, 6 questions in Attitude to use, and 6 questions in Behavioral intention. Each student was given a PDA to use for information retrieval, communication and recording observations.

The inter-rater reliability of the whole scale in the pre-test was 0.951. The Cornbach's α for every construct lies between 0.835~0.913. Also, the potential degree of value of Composite Reliability (CR) lies between 0.751~0.860. Each construct of CR value is greater than 0.7 showing the literary composition surface of this research has a very good internal consistency (Fornell and Larcker, 1981) as shown in Table 4.

Experiment design

The experimental procedures mainly comprise "auxiliary teaching" and "DIY field trial teaching" activities for ecological teaching navigation in this research. It focuses on the learning experience of knowledge in the short time and undergos the whole resource introduction and field trial in the geographical environment. Courses arranged adopting mixed teaching activities which contain auxiliary teaching involved in inquiry-based learning (IBL) and DIY field trial involved in flow learning (FL). According to the e xperimental procedures of IBL and FL, an integrated synopsis of teaching activities for IBL and FL was shown in Table 5.

There are two stages in the experiment of teaching activity. In the first stage, the students has received a preliminary understanding of plant ecology and viewed relevant data by PDA, the teachers proceed teaching

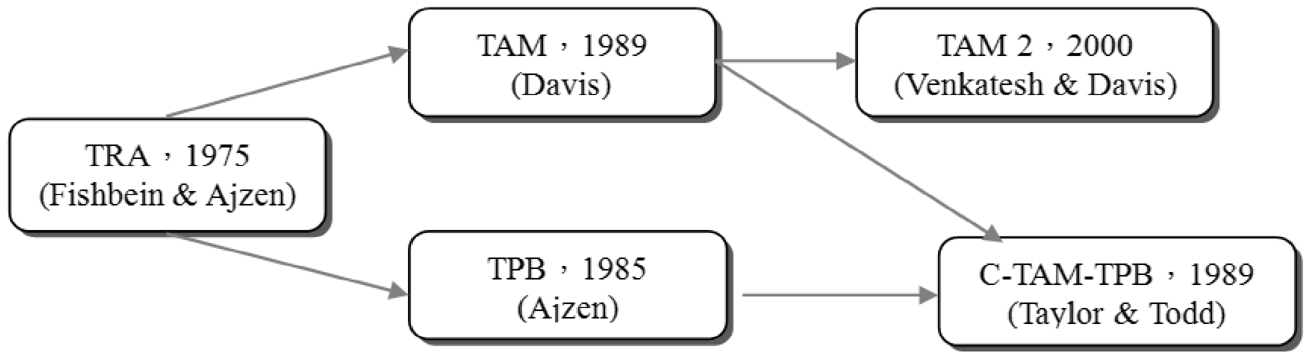

Figure 5. The proceedings map of TAM theory models

Table 4. Reliability analysis results for 7 constructs

Constructs	CR	AVE	Cornbach's α
Learning motivation	0.860	0.739	0.894
Material characteristic	0.860	0.631	0.848
Systemic characteristic	0.860	0.564	0.899
Perceived usefulness	0.851	0.739	0.913
Perceived ease of use	0.794	0.590	0.869
Attitude to use	0.768	0.740	0.835
Behavioral intention	0.751	0.724	0.901

Table 5. Integrated synopsis of teaching activity for IBL and FL

Inquiry-Based Learning	Auxiliary teaching (content list)	**Flow Learning**	DIY field trial (content list)
Inquire	To explain the teaching of PDA navigation	**Arouse enthusiasm**	Application of field trial activity.
Investigation	Design teaching activity to put forward the question and explore.	**Focus attention**	Explain the content of plant.
Construction	Look for the ecological navigation site and observe plants.	**Direct experience**	The experience of feeling includes voice, touch, and wind blow; fetch the food, nest, hide, taste, sense touch, color and luster.
Discussion	Discuss and interact in the group.	**Share enlightenment**	DIY creates including seed craft and rubbing, etc., Taking pictures and sharing the works. Application of field trial activity.
Introspection	Answer the question and self-evaluation.		

a: PDA Login interface with RFID Reader sensor

b： PDA system functions

c: Plant nameplate

d: Read message from QR Code or RFID Tag

e: Plant content display

f: Plant description

Figure 6 (a-f). Design of JMNS's interface on PDA

Figure 7. Learning activity of plant ecology

activity by using PDA mobile devices. In the second stage, the students used PDAs to observe plant ecology outdoors.

Information regarding the plant ecology was wirelessly sent to the students' PDAs. The students followed the instructions of operating flow diagrams shown on their PDAs and observed the detailed information of plant. The procedures of JMNS interface were shown in Figure 6 (a~f).

The students followed the instructions shown on their PDAs and learned the knowledge, characteristics of the plant, as shown in Figure 7.

Following the observation session, the students started a reflection stage. A series of questions belong to JMNS's characteristics including learning motivation, material characteristic, systemic characteristic, perceived ease of use, perceived usefulness, attitude to use, and behavioral intention were evaluated to examine attitude and behavioral intention for students.

Data analysis

The questionnaire includes different parts which are corresponding to the seven constructs of JMNS. Each construct has several items in the questionnaire and adopts five-point Liker Scale. The participated students received a prior knowledge experience about plant ecology activity, a pre- and post-test to evaluate their reflection levels, and the QUIS questionnaire was conducted to access their learning intention.

At the end of formal experiment, fifty-nine valid questionnaires were collected. The sampling accuracy assessed by the Kaiser-Meyer-Olkin (KMO) is .794 which is higher than the recommended value of .60 (Kaiser, 1974). After that, the factor analysis was used to examine the convergent validity between items in the same construct and the discriminant validity between items among different constructs. The principal component method of factor analysis was used with Varimax (orthogonal) rotation.

This research uses SPSS 18.0 for Windows statistical analysis software as the tool of analysis. Learning motivation, material characteristic, and systemic characteristic were independent variables, and mean difference between the pre- and post-test as the depentdent variable to conduct a one-way ANOVA to explore the effects of learning intention on students' reflectin levels. Beside, descriptive statistics, analysis of reliability and validity, Independent-Samples T Test, path analysis and the Structure Equation Models (SEM) are used to explain all 23 hypothesize questions.

RESULTS AND DISCUSSIONS

The aim of this research is to discuss mobile learning applied on different teaching situations, take ecological teaching navigation for example to integrate different learning models like IBL and FL into teaching activities so as to enhance learning motivation and interest.

The first test performed to confirm whether there are any significant relationships among independent variables and seven different constructs by analyzing the data collected from the questionnaire. Questionnaire was evaluated by independent t-test analysis, One-Way ANOVA. Significant differences ($p < .000$) were found for gender, navigation experience, age, department, and mobile devices.

Secondly, the analyzed results from the mobile navigation and teaching activity relate to TAM by learners. Questionnaire was evaluated by Visual PLS structural model. Significant differences ($p < .000$) were found among seven constructs related to TAM was shown in Table 6.

Beside, using Visual PLS structural model to analyze and discuss the consistency between final concepted model and original model. PLS focus on the indicators of R2, β, p and assess the relationship and cause-effect among external variables. The result of path analysis for different variables in this research showed in Figure 8.

Finally, the results from research can be summarized as follows: (a) most learners agreed that using mobile navigation and teaching activity is apt to increase learning motivation, learning interest and interaction, and further affect the intention to use in such a flexible, mobile, ubiquitous, and joyful environment. (b) Many learners also acknowledged that learning with JMNS was much interesting than learning with a traditional teaching method. The system developers should design and improve the interface of teaching navigation system to have more comfortable and convenient learning intention; and (c) some learners expressed that using JMNS in teaching activity can simultaneously increase their motivations and offer a more joyful perception to learners during the learning process.

With the results stated above, some discussins and implications can be further elaborated. The assessment of the Joyful Mobile Nevigation Systems (JMNS) was conducted with respect to following questions. (a) Can the designed JMNS help learners to have positive and alluring learning motivation? (b) How do learners perceive the usefulness and ease of use of the JMNS?

Firstly, the design of JMNS's interface was fond that joyful learning had positive influences on learning motivation. Many students were observed that they showed a high degree of curious, interesting, attentive, objective, confident attitude in interacting with the JMNS. When students have higher joyful perceptions and interests during the learning process in ecological teaching activity, their learning motivations will be higher and their learning outcomes will also be better.

Table 6. The Path Analysis among constructs related to TAM

	Cause-Effect Path		*β*	*t*
Constructs	Learning motivation	Perceived usefulness	0.340	3.943^{***}
	Learning motivation	Perceived ease of use	0.339	2.668^{**}
	Material characteristic	Perceived usefulness	0.193	2.374^{*}
	Material characteristic	Perceived ease of use	-0.080	-1.048
	Systemic characteristic	Perceived usefulness	0.087	1.117
	Systemic characteristic	Perceived ease of use	0.505	5.116^{***}
	Perceived ease of use	Perceived usefulness	0.320	3.525^{***}
	Perceived usefulness	Attitude to use	0.547	6.372^{***}
	Perceived ease of use	Attitude to use	0.243	2.896^{***}
	Perceived usefulness	Behavioral intention	0.365	4.001^{***}
	Attitude to use	Behavioral intention	0.449	5.897^{***}

* *Statistically significant at p <0.05* (two tails)
***Statistically significant at p <0.01* (two tails)
****Statistically significant at p <0.001* (two tails)

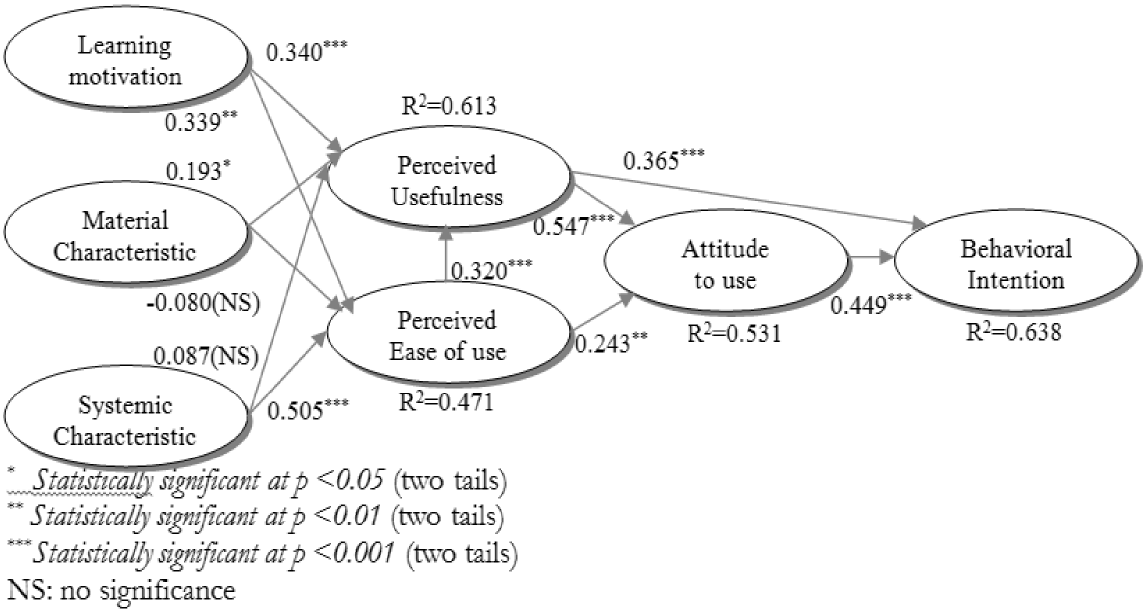

Figure 8. The path analysis among seven constructs

Secondly, in the pilot experiment, students expressed their concern about using RFID tags for reading messages might take too much time than directly reading on the books in the class. In other words, few students were worried about the complexity of operating the JMNS devices. In this research, two independent constructs of TAM, namely perceived usefulness (PU) and perceived ease of use (PEOU) were adopted. The main purpose focused on understanding how the students felt about the JMNS on usefulness and ease of use. Therefore, in the formal experiment, the data of the PU and PEOU based on the TAM questionnaire were collected to confirm the acceptance of the JMNS for students' behavioral intention.

CONCLUSION AND RECOMMENDATIONS

The features of mobile navigation and teaching activity create a flexible and productive context that can accommodate various learning activities. In this research, students studied in ecological course by using mobile devices such as PDAs, GPS and RFID in a mobile learning environment. After the "auxiliary teaching" and "DIY field trial" of a series of observation sessions, the students were instructed to response on what they had just learned. This research considered different variables that might influence the students' reflection, including seven construtcs: learning motivation, material characteristic, systemic characteristic, perceived usefulness, perceived ease of use, attitude to use, and behavioral intention. Integrating Inquiry-Based Learning (IBL) and Flow Learning (FL) and familiarizing into ecological navigation teaching activity.

This research is to design and evaluate a JMNS for discussing learners' learning by using PDAs, GPS, and RFID technologies. The results show that the systemic characteristic of JMNS can help learners to have better and clear learning process in terms of joyful and flexible human-compuer interface so as to have perceived ease of use. Besides, many learners responded that material characteristic is the main effect to affect mobile navigation and teaching activity. The systemic developer should be devoted to improving and designing plentiful and various teaching methods. The main contribution of this research is to show the integrating learning models applied on outdoor teaching activity and mobile technologies to assist learners to do ecological learning.

There are two limitations in this research. Firstly, this research didn't investigate the learning performance was only focused on the design and assess the JMNS to support learners' learning motivation and interest. The second limitation is the material contents designed only for the ecological course and teaching activity to enhance learning motivation but not suitable for adaptive learning. The future research should consider different learning contents driven by JMNS and go on adopting that system to discuss the JMNS's learning effects from learners. And it should be a very presumable future research topic.

Furthermore, the features of u-learning environment create a smart and flexible context that can accommodate various learning activities. Instructors are thus encouraged to probe students' learning styles and also develop teaching strategies that correspond to the students' needs.

Nowadays, entire campuses are learning to be smart. The main contribution of this research is to show the feasibility and potential of applying educational JMNS devices and RFID technologies to help students to enhance learning intentioin. The applications of RFID devices on campuses become more and more pervasive. The school authorities should design adaptive learning contents driven with joyful, flexible, mobile and ubiquitous features to assist students to learn anytime and everywhere.

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