

Review

Elementary school student's acceptance of Lego NXT: The technology acceptance model, a preliminary investigation

Bih-Yaw Shih¹, Chia-Hung Shih¹, Chien-Chung Li¹, Tsung-Hao Chen², Ying-Hsiu Chen³ and
Chen-Yuan Chen^{4,5,6*}

¹Department and Graduate School of Computer Science, National Pingtung University of Education, No. 4 to 18, Ming Shen Road., Pingtung 90003, Taiwan.

²Department of Business Administration, Shu-Te University, Yen Chau, Kaohsiung 82445, Taiwan, R.O.C.

³Department of Finance, Yuanpei University, No.306, Yuanpei Street, Hsinchu 30015, Taiwan.

⁴Department and Graduate School of Computer Science, National Pingtung University of Education, No. 4-18, Ming Shen Rd., Pingtung 90003, Taiwan, R.O.C.

⁵Global Earth Observation and Data Analysis Center (GEODAC), National Cheng Kung University, No 1, Ta-Hsueh Road, Tainan 701, Taiwan, R.O.C.

⁶Doctoral Program in Management, National Kaohsiung First University of Science and Technology, Taiwan, R.O.C.

Accepted 25 May, 2011

The Lego NXT Software Development module had successfully used challenges and emulations to improve the student experience, but these challenges were somewhat artificial in nature. It was expected that the use of the Lego models would supply more focus for the students and enable them to prep over the course of the module, building on their knowledge each week, on the development of a meaningful achievement. The purpose of the study is to develop an evaluation for students' acceptance of Lego NXT as an intention to forecast, explain, and improve application patterns of technology acceptance model (TAM).

Key words: LEGO NXT, intention, behavior, technology acceptance model (TAM), artificial intelligence, intelligent NXT robot.

INTRODUCTION

The application of computer technology in classrooms has been demonstrated to improve teaching when used appropriately (Surry and Land, 2000). In the past few years, many teachers have introduced Lego NXT to their classes as a way to improving the effectiveness of learning of Commonly, robots are used in introduction to computer science courses. At the George Washington University, the CS 001 introductory class exclusively uses Lego to teach problem solving using computers and applications of computer science to the real world. Robots have also been used in single-topic computer science courses. One of the areas that robots are most often used for pedagogical purposes is the field of

artificial intelligence. Villanova University has used robots to teach computer organization and operating systems concepts.

A common feature those courses is that none of them require students to design a software artifact from a specification using software engineering practices. In the introductory courses, the projects are fairly simple, like pushing cans out of a dark area of a board, or programming a robot to follow a line by using a light sensor.

The well-being of the project and publication of its results would latently encourage teachers to come up with other innovative ways of using this technology.

There are lots of researches about robots use in computer science courses at universities, but we have poor information to know how about that elementary school students use Lego NXT system in their studies,

*Corresponding author. E-mail: cyc@mail.npue.edu.tw.

the researcher hope to provide the relevant information.

Research questions

The primary reason for the study is to measure if elementary school students, at this class, accept the Lego NXT cause. The second question verification is the efficiency of technology adoption as determined by the technology acceptance model (TAM). The third question positioned by this study is the impact of the various TAM variables, and other variables not included in the TAM model, on user acceptance of the Lego NXT.

H₁: Lego NXT self efficacy does have an impact on perceived usefulness.

H₂: Lego NXT self efficacy does have an impact on perceived ease of use.

H₃: Subjective norm does have an impact on perceived usefulness.

H₄: Subjective norm does have an impact on perceived ease of use.

H₅: Facilitating conditions does have an impact on perceived usefulness.

H₆: Facilitating conditions does have an impact on perceived ease of use.

H₇: Perceived usefulness does have an impact on attitude toward using.

H₈: Perceived ease of use does have an impact on attitude toward using.

H₉: Perceived ease of use does have an impact on perceived usefulness.

H₁₀: Attitude toward using does have an impact on behavioral intention to use.

H₁₁: Perceived usefulness does have an impact on behavioral intention to use.

The survey questions were manufactured to constructs of the TAM model with some constructs. These are included from the TAM to measure the acceptance or rejection of the individual hypothesis. The manufacturing of the questions is described subsequently in the research design of this dissertation.

Significance of the study

Recently, soft computing and artificial intelligence have been successfully applied to the nonlinear system, such as robot manipulation (Hsiao et al., 2005a, b, c, d, e; Chen et al., 2011a, b; Chen and Huang, 2011; Shih et al., 2011a, b; Lee et al., 2011a, b, c), engineering application (Lu, 2003; Amini and Vahdani, 2008; Chang et al., 2008; Chen, 2006; Chen et al., 2008d, e; Trabia et al., 2008; Tu et al., 2008; Yang et al., 2008a; Shih et al., 2010b), architectural engineering (Chen et al., 2004; Chen et al., 2010i; Hsieh et al., 2006; Chen, 2010a, b, c; Hsu et al., 2010; Chen, 2011c, d, e; Chen et al., 2011c, d; Liu et al., 2011; Tang et al., 2011), satellite

observations (Lin et al., 2009a, b; Lin and Chen, 2010b), marine research (Chen et al., 2005a, 2005b; Chen et al., 2006a, b, c; Chen et al., 2007a, b, c, d, e, f, g, h; Chen et al., 2008a, b, c; Tseng et al., 2009; Chen, 2009b, c; Chen et al., 2009c; Chen, 2010d; Chen, 2011a, b, c), network optimization (Chen et al., 2009g; Chen and Chen, 2010b; Shih et al., 2010a, c; Kuo et al., 2010; Kuo et al., 2011; Kuo and Chen, 2011a, b), system development (Chen, 2009a; Chen et al., 2009a, b, d, e, f; Chen, 2010c; Chen et al., 2010a, c, d, f; Lin and Chen, 2010a; Shih et al., 2011d; Tseng et al., 2011), educational improvement (Chen et al., 2010b; Shih et al., 2010d; Shen et al., 2011; Shih et al., 2011c; Chen, 2011f; Chen, 2012) and managements on leisure and tourism industries (Yildirim et al., 2009; Zhao et al., 2009; Tsai et al., 2008; Yang et al., 2008b; Yeh et al., 2008; Chen and Chen, 2010a; Chen et al., 2010e, g, h; Lee et al., 2010a, b; Chiang et al., 2010; Yu et al., 2011; Chen et al., 2011e). Moreover, there are some studies that focus on the adoption of information technology beginning in 1975 that is the theory of planned behavior by Fishbein and Ajzen (1975). The technology acceptance model was put forward by Davis in 1989 (Davis, 1989) followed by some studies that was supported and suggested modification of the TAM model (Mathieson, 1991) (Legris et al., 2003). The project will research a relatively new model, TAM, to determine the acceptance of an information technology initiative by elementary school students. This study will test the validity of the TAM model in a situation.

The study could help academic institutions with their decisions whether or not to carry out a new information system technology. The discovery of this research can indicate areas that could improve the acceptance of technology implementations.

Although this study does not survey the financial impact of LEGO NXT initiatives, it may help academic institutions with the decision of adopting this new technology.

LITERATURE REVIEW

Information systems research literature is rich with articles about organizational and individual acceptance of information systems (IS) innovations. Explaining how end user chooses to accept technical innovations require psychology based theories. Social cognitive theory (SCT) is a broad psychometric research area that studies the factors involved in individual decision making. SCT distinguishes itself from traditional social learning theory by incorporating mental processing (cognition) into the interpretation of observational learning. Albert Bandura, of Stanford University, has led development of SCT since the 1960's. His research is important to technology acceptance models because he laid the foundation allowing us to understand human behavior. Bandura postulates that human behavior is a triadic, dynamic, and reciprocal interaction of three factors: Personal factors,

behavior, and the environment (Bandura, 1977). While some social scientists propose that behavior is a result of consequences, SCT postulates that goal-directed and self-regulation processes play a large part in how we react to different situations. Furthermore, SCT suggests that there are both direct and indirect effects of reinforcement that learners conscientiously choose. Bandura's research stimulated researchers to study techniques for promoting organizational change and measuring the success of change.

Recently Bandura has moved his primary research to health psychology (Bandura, 2002). A new branch of research has developed that the use of the principles of social cognitivism proposed by Bandura, and others, to measure the acceptance of technical innovations. These theories can be collectively referred to as technology acceptance models. The history and progression of technology acceptance models in depth is discussed here. The technology acceptance model (TAM) model including its underlying construction, previous applications, and its similarity to other implementation models is also discussed.

Lego NXT system

An educational version of the Lego NXT system is available through Lego education. In the early 1990s, Lego Dacta wired computer interface, and was well integrated into courses. Then the first autonomous CodePilot (1997) could be programmed using barcodes (1998) based on 8-bit Microcontroller, 32 KB RAM, IR serial communication, iconic programming language with parallel events; It is used in many competitions (First Lego League, RoboCup, LineFollowing, Micromouse, etc.) and help countless students predominate science, technology, engineering, and math concepts with hands-on, naturally motivating building sets, programming software, and schemes of work. Many alternative programming environments, the last RCX are improved to NXT (2006).

With the new intelligent brick, expanded sensor capabilities, updated programming software, and new schemes of work, Lego NXT Education enables students to complete assigned challenges with more option; they can build stronger and smarter robots that more closely mimic real-world machines.

The adoption of technological innovations

Many researchers have put out various theories that could be used to explain the adoption of information technology innovations. These theories are: The technology acceptance model (TAM) (Davis et al., 1989); the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975); and the theory of planned behavior (TPB) (Ajzen, 1991) etc. which are modifications or developments of

these models. These researches are more penetrate deeply discussed in literature reviews and research design of this study.

The models helped to appraise and measure the Information Systems (IS) innovation that was accepted. An appraisal of the success rate of new Information Systems (IS) technology implementation projects were about 50% since the 1980s (Westland and Clark, 2000). According to generating a significantly higher percentage of technology innovation success the TAM is considered a well metric than the prior metrics.

About the history of technology acceptance models

Technology acceptance models (TAM) have been evolved to measure system use, acceptance, and user satisfaction of those systems (Davis et al., 1989). The Davis model mainly focuses on information systems use and is based on the theory of reasoned action (TRA) previously introduced by Ajzen and Fishbein (1980) and evolved as extended by Ajzen TRA in 1991 (Ajzen, 1991).

TRA is a technology acceptance model that is used not only for the adoption of information systems technology, but also to forecast behavior in a variety of situations. The users' attitude adds in subjective norms to construct the behavior intentions of each unit. This theory was further refined to the theory of planned behavior (TPB) which is also called the extended theory of reasoned action. The TPB is a general behavior model that can be used to research wider acceptance situations than the TAM but it had been implanted to information systems studies (Mathieson, 1991; Taylor and Todd, 2001).

Figure 1 illustrates the theory of planned behavior. The model helps to resolve how to affect the behavior of individual. Ajzen raised the model to predict deliberate behavior, because behavior can be deliberate and planned.

TPB comprises many elements, or constructs, used to decide users' acceptance of innovations. The three considerations are behavioral beliefs, normative beliefs, and control beliefs. The users core beliefs include the consequences of the action, the expectations of others, and beliefs about how the user controls, or does not control the end result of the behavior.

The complication of TPB model limits its use in information systems research. TPBs include more variables than may be important in most information systems technology implementations (Taylor and Todd, 2001). Some of the variables have been removed from the TPB. But they have shown up in more modern models such as the influence of people considered significant by the participants. These factors to modern acceptance models are important.

The technology acceptance model

The TAM thinly became the accepted model for research

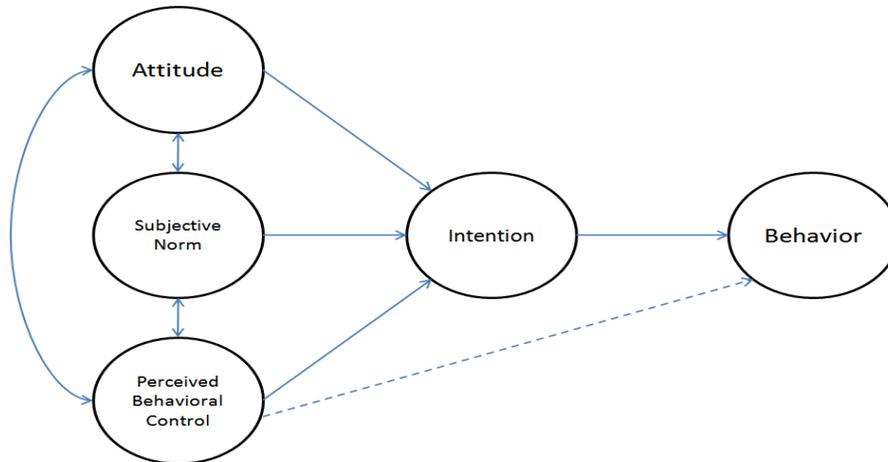


Figure 1. Theory of planned behavior.

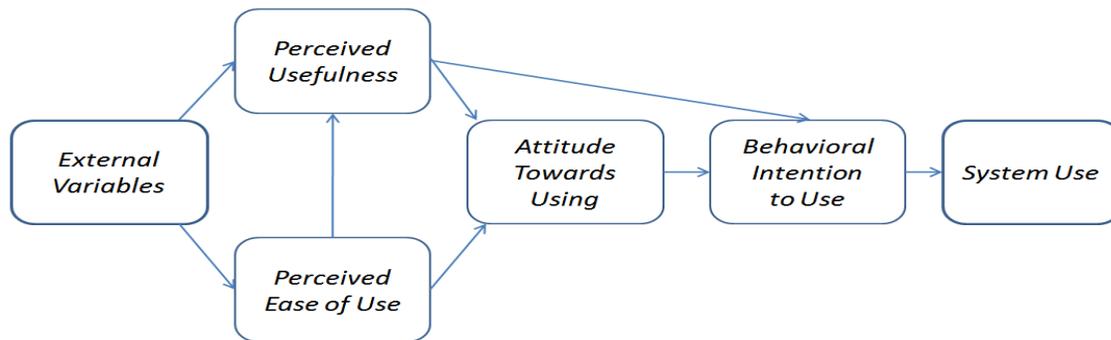


Figure 2. The technology acceptance model (Davis et al., 1989).

in information systems adoption modes. The advantage of a TAM is that it is specifically designed to used the acceptance of IS technology. The TAM model replaced the first three attitudinal constructs from the TPB with two technology acceptance measures, perceived usefulness and perceived ease of use. This was done in an attempt to simplify the model making prediction of acceptance easier to predict.

The two theoretical components that are the foundation of Davis's TAM model (Davis et al., 1989: 985) include the perceived usefulness (PU) and perceived ease of use (PEOU) (Figure 2). Davis defines usefulness as "the degree to which a person considers that using a specific system may enhance his or her job performance;" and define perceived ease of use as "the degree to which a person considers that using a particular system may be less of effort" (Davis et al., 1989: 985).

An identified limitation of TAM does not take into account consideration of any obstacles that would protect an individual from adopting a special information systems technology (Taylor and Todd, 2001).

Venkatesh and Davis expected to include these

arguments of external factors into a TAM model when they proposed a model in 2000 extending the TAM. The new model includes social influence processes and cognitive processes.

In additional, factors not in original TAM models need to be included. Those variables are demographics, managerial knowledge, social factors, environmental characteristics, and task-related characteristics (Pijpers, 2001).

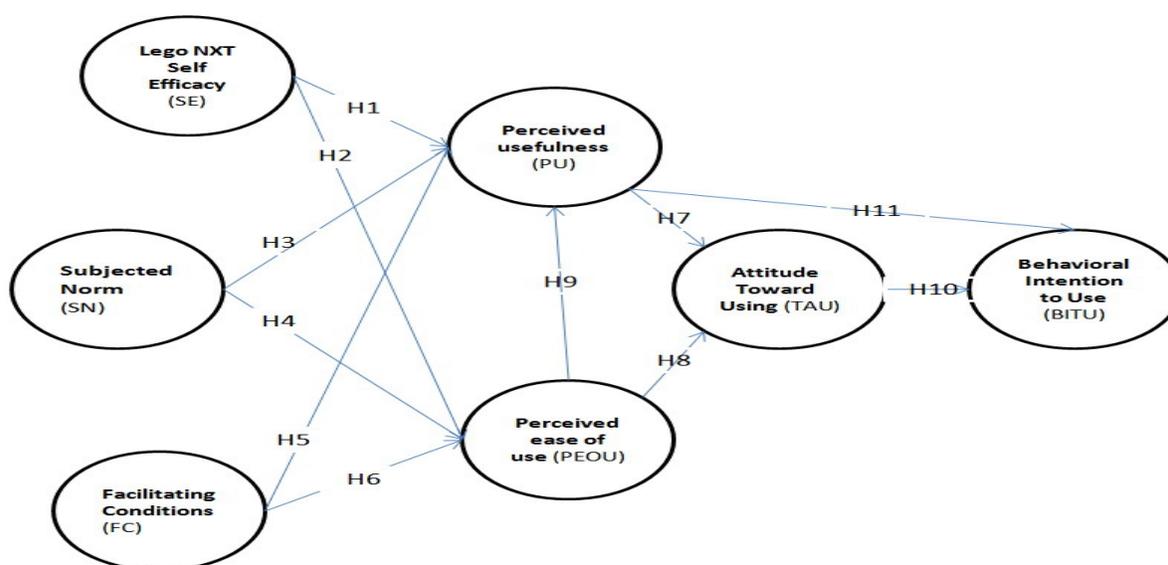
Some examples of such additional factors are the motivational factors introduced by Vallerand (1997).

About the Information Systems, research has validated the TAM. Table 1 presents a reference list of researchers and dates that have used the TAM model to study their technology acceptance research problems.

The main of research validates and extends the application of TAM. But TAM is just to predicting technology adoption success between 30% (Meister and Compeau, 2002) and 40% of the cases (Venkatesh and Davis, 2000). Finally, researchers have searched for better technology acceptance models that can deliver a higher prediction of success (Legris et al., 2003) (Plouffe et al., 2001).

Table 1. TAM research (Legris et al., 2003).

Year	Author	Model used
1989	Davis	TAM
1992	Davis and Bagozzi	Extended TAM
1991	Mathieson	TAM and TPB
1995	Taylor and Todd	TAM + subjective norm
1997	Jackson	TAM + validation tools
1998	Bajaj et al.	TAM + loop back adjust
1999	Hu et al.	TAM
2000	Venkatesh and Davis	TAM + subjective norms
2002	Hwang and Yi	TAM + goal orientation, CSE

**Figure 3.** The use Lego NXT TAM model.

RESEARCH DESIGN

The objective of this study was based on the technology acceptance model raised by Davis in 1989, to present this study to measure the acceptance of Lego NXTs by Elementary school students at Pingtung County. The research framework is as shown in Figure 3. Based on the figure, researcher hoped to test and verify the external variables, what is the impact of TAM model?

The research questions guiding this study are:

H₁: Lego NXT self efficacy does have an impact on perceived usefulness.

H₂: Lego NXT self efficacy does have an impact on perceived ease of use.

H₃: Subjective norm does have an impact on perceived usefulness.

H₄: Subjective norm does have an impact on perceived ease of use.

H₅: Facilitating conditions does have an impact on perceived usefulness.

H₆: Facilitating conditions does have an impact on perceived ease of use.

H₇: Perceived usefulness does have an impact on attitude toward using.

H₈: Perceived ease of use does have an impact on attitude toward using.

H₉: Perceived ease of use does have an impact on perceived usefulness.

H₁₀: Attitude toward using does have an impact on behavioral intention to use.

H₁₁: Perceived usefulness does have an impact on behavioral intention to Use.

The participants of this study were elementary school students who had been using the Lego NXT for about a week. The sample of student participants is about 80 students. The instrument used to gather adoption data

Table 2. Measurement of variables.

Latent variable	Measurement of variable
Perceived usefulness (PU)	Use Lego NXT attend class can improve my degree of understanding Use Lego NXT attend class is helpful in learning Use Lego NXT attend class can enhance my learning effect
Perceived ease of use (PEOU)	The environment of use Lego NXT attend class is easy to understand Use Lego NXT attend class is simple and clear For me, steps of use of Lego NXT is easy to remember Overall, I think that environment of Lego NXTs attend class are easy to use
Attitude toward using (ATU)	I like to use the Lego NXT attend class Lego NXT let me want to use it to learn constantly Use Lego NXT attend class is the experience of pleasure I found that use Lego NXT attend classes is fun I am very pleased to have an experience that to use Lego NXT attend class
Behavioral intention to use (BITU)	I hope that use Lego NXT to help me in learning later I hope the course increase the use of Lego NXT If I opportunities to access Lego system, I will use it Use Lego class to me was a wise decision
Lego NXT self efficacy (SE)	The using of the Lego NXT experience was better than I expected Lego NXT provides the picture better than I expected The picture of Lego NXT can meet the requirements of mine I am very satisfied with the function of Lego NXT class
Subjective norm (SN)	I was attracted by Lego NXT strongly I focus on the Lego NXT I am very interested in classes for the use of Lego NXT
Facilitating conditions (FC)	Lego NXT attend class environment provides an attractive learning environment Lego NXT is a system that has fun to use Classes using Lego NXT can provide complete information I believe Lego NXT easily implement what I want it to do

was a paper survey based on the variables defined in this study. The survey tool presented questions based on the technology acceptance model (TAM) Model. These questions were added as suggested by a group of technology acceptance researchers. Close to 80 questionnaires were distributed and 69 were returned (88%).

Related valuables

The most common method used for information systems research for moderator analysis is regression analysis. Partial least squares are used frequently in the research literature concerning psychometric evaluations. The dissertation model consists of seven latent variables, or constructs.

The statistical analysis method used for this dissertation was partial least squares (PLS), a powerful second generation statistical technique of covariance based structural equation modeling. The software was used to determine the validity of the various measurements or questions (Table 2). The questions contained in the survey instrument were evaluated for variance (R^2) and retained if the variable had a variance greater than 0.7.

The TAM model theorizes that four constructs have a significant determination on user acceptance of IT innovations (Venkatesh et al., 2003).

Lego NXT self efficacy (SE)

Lego NXT self efficacy has been defined in the following list of ways: As the belief that one is capable of

performing in a certain manner to attain certain goals (Ormrod, 2006). It is a belief that one has the capabilities to execute the courses of actions required to manage prospective situations. It has been described in other ways as the concept has evolved in the literature and in society: As the sense of belief that one's actions have an effect on the environment (Steinberg, 1998). In this variable, students understanding how to foster the development of Lego NXT self efficacy is an important goal for positive psychology because it can lead to acquiring more delight.

Subjective norm (SN)

Subjective norm belongs to social influence, that is, it is the degree to which an individual perceives that others believe he/she should use the new systems. This construct deals with the notion that the individuals' behavior is influenced by the way in which they believe others will view them as a result of using the technology. The importance of social factors becomes more significant in mandated environments as postulated by Venkatesh and Davis (2000). In mandatory adoption settings, social influence appears to be significant only in the early stages with its effect eroding over time.

Facilitating conditions (FC)

Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the Lego NXT. Four common TAM research questions will be used to measure this construct. According to Venkatesh et al. (2003), this variable was not significant as a determinant of intention. However this variable was retained because of discussion pertaining to its importance in other publications (Taylor and Todd, 2001).

Perceived usefulness (PU) and perceived ease of use (PEOU)

The extant literature on technology acceptance and adoption highlights the importance of perceived usefulness and ease of use as the main indicators of whether a person is willing to adopt or use new technology, particularly in the case of user acceptance of computers (Davis, 1989; Mathieson, 1991; Taylor and Todd, 2001). TAM studies have proposed that the effect of perceived ease of use (PEOU) is often less significant on acceptance than is the effect of perceived usefulness (PU) (Davis, 1989; Keil et al., 1995). In the light of the technology acceptance literature, perceived ease of use is hypothesized to affect perceived usefulness (Davis, 1989; Venkatesh et al., 2003).

Attitude toward using (ATU)

Attitude toward using has been defined as individual's positive or negative feeling about implementation of the target behavior (e.g., using a system).

Behavioral intention to use (BITU)

Behavioral intention to use has been defined as the degree to which a person had developed conscious plans to implement or not implement some specified future behavior.

Sample size

A method of determining the necessary sample size for a survey is based on the error the researcher is willing to accept. It is popular in the social sciences to try to reach a statistical effect of at least 95% confidence or an alpha of 0.05. Using the method and a table provided by Cohen (1988: 52), one of the effects of using PLS is that it can resample the initial data set enlarging it thus reducing overall sample conditions. Guidelines provided with PLS recommend a sample size equal to the larger of two possibilities: (1) Ten times the number of indicators on the most formative construct; in this study, ten times the ten indicators of performance expectancy or one hundred participants, or (2) Ten times the largest number of antecedent constructs used to determine a dependent variable; in this study, ten times seven is the number of constructs used to determine behavior intent.

Survey questions

At present, in the literature related to technology acceptance model, most of the researchers gathered information through the questionnaire. In the study, all variables were measured with a question presented using a five-point Likert item, with the complete questionnaire data following it. At the same time, the moderating factors, to a varying degree, have an effect on each of the constructs stated in the two equations given in the foregoing.

There are unobservable factors that have an effect on the model and are measured in the determination of the variables and are included to arrive at a good estimation of acceptance. Partial least squares has been documented to be able to account for these factors and calculate the correct weights allowing researchers to study the strength and direction of the relationships between model variables and the relationships between moderating variables simultaneously (Fornell and Bookstein, 1982; Lohmoller, 1989; Igbaria, 1994; Chin et al., 2003).

Conclusions

This study proposed the concept on Lego NXT affecting the interpretation of model attempt to find out the intention of using the Lego NXT possible factors. The researcher attempt from three factors of the Lego NXT; self efficacy, subjective norm and facilitating conditions to discussion on TAM model; and hope to identify that suitable for elementary school children to learn using Lego NXT technology acceptance model. This is a part for further studying on data collection and analysis.

Acknowledgment

The authors are appreciative of the financial support in the form of research grants to Dr. Chen-Yuan Chen from the National Science Council, Taiwan under Grant Nos. NSC 99-2628-E-153-001 and NSC 100-2628-E-153-001. The authors are also most grateful for the kind assistance of Editor of IJPS, and for the constructive suggestions from the anonymous reviewers, all of which has led to the making of several corrections and have greatly aided us to improve the presentation of this paper.

REFERENCES

- Ajzen I (1991). The Theory of Planned Behavior. *Organizational Behaviour and Human Decision Processes*, 50: 179-211.
- Amini F, Vahdani R (2008). Fuzzy optimal control of uncertain dynamic characteristics in tall buildings subjected to seismic excitation. *J. Vibration Control* 14: 1843-1867.
- Bandura A (1977). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura A (2002). *Social Cognitive Theory in Cultural Context: An International Review*. *J. Appl. Psychol.*, 51: 269-290.
- Chen CW, Chiang WL, Hsiao FH (2005a). Stability Analysis of T-S Fuzzy Models for Nonlinear Multiple Time-Delay Interconnected Systems. *Math. Comput. Simulation*, 66: 523-537.
- Chen CY, Hsu RC, Chen CW (2005b). Fuzzy Logic Derivation of Neural Network Models with Time Delays in Subsystems. *Int. J. Artificial Intelligence Tools*, 14: 967-974.
- Chen CW, Chiang WL, Tsai CH (2006a). Fuzzy Lyapunov Method for Stability Conditions of Nonlinear Systems. *Int. J. Artificial Intelligence Tools*, 15: 163-171.
- Chen CY, Hsu JRC, Chen CW, Cheng MH (2006b). Numerical model of an internal solitary wave evolution on impermeable variable seabed in a stratified two-layer fluid system. *China Ocean Eng.*, 20: 303-313.
- Chen CY, Tseng IF, Yang HC, Chen CW, Chen TH (2006c). Profile Evolution and Energy Dissipation for Internal Soliton Transmitting over Different Submarine Ridges. *China Ocean Eng.*, 20: 585-594.
- Chen CW (2006). Stability Conditions of Fuzzy Systems and Its Application to Structural and Mechanical Systems. *Adv. Eng. Software*, 37: 624-629.
- Chen CW, Chen CY, Yang HC, Chen TH (2007a). Analysis of Experimental Data on Internal Waves with Statistical Method. *Engineering Computations*. *Int. J. Comput. Aided Eng. Software*, 24: 116-150.
- Chen CY, Hsu, John RC, Chen CW (2007b). Generation of internal solitary wave by gravity collapse. *J. Marine Sci. Technol.*, 15: 1-7.
- Chen CY, Hsu, John RC, Chen CW (2007). Wave propagation at the interface of a two-layer fluid system in the laboratory. *J. Marine Sci. Technol.*, 15: 8-16.
- Chen CW, Lin CL, Tsai CH (2007c). A Novel Delay-Dependent Criteria for Time-Delay T-S Fuzzy Systems Using Fuzzy Lyapunov Method. *Int. J. Artificial Intelligence Tools*, 16: 545-552.
- Chen CY, Lin CL, Tseng, I. F., Chen CW (2007d). Dynamic behavior of an internal solitary wave oscillating over variable bathymetry. *Kuwait J. Sci. Eng.*, 34: 153-166.
- Chen CY, Chen CW, Tseng IF (2007e). Localised mixing due to an interfacial solitary wave breaking on seabed topography in different ridge heights. *J. Offshore Mech. Arctic Eng.*, 129: 245-250.
- Chen CW, Yeh K, Chiang WL, Chen CY, Wu DJ (2007f). Modeling, H^∞ Control and Stability Analysis for Structural Systems Using Takagi-Sugeno Fuzzy Model. *J. Vibration Control*, 13: 1519-1534.
- Chen CY, Yang HC, Chen CW, Chen TH (2008a). Diagnosing and revising logistic regression models: effect on internal solitary wave propagation. *Eng. Computat. Int. J. Comput. Aided Eng. Software*, 25: 121-139.
- Chen CW, Yang, Peter HC, Chen CY, Chang AKH, Chen TH (2008b). Evaluation of inference adequacy in cumulative logistic regression models: an empirical validation of ISW-ridge relationships. *China Ocean Eng.*, 22: 43-56.
- Chen CY, Hsu, John RC, Cheng MH, Chen CW (2008c). Experiments on mixing and dissipation in internal solitary waves over two triangular obstacles. *Environmental Fluid Mech.*, 8: 199-214.
- Chen PC, Chen CW, Chiang WL (2008d). GA-Based Fuzzy Sliding Mode Controller for Nonlinear Systems. *Mathematical Problems in Engineering- An Open Access J.* DOI: 10.1155/2008/325859.
- Chen TH, Chen CY, Yang CH, Chen CW (2008e). A Mathematical Tool for Inference in Logistic Regression with Small-Sized Data Sets – A Practical Application on ISW-Ridge Relationships. *Mathematical Problems in Engineering- An Open Access J.* DOI: 10.1155/2008/186372.
- Chen CW (2009a). Modeling and control for nonlinear structural systems via a NN-based approach. *Expert Syst. Appl.*, 36, 4765-4772.
- Chen CW (2009b). The stability of an oceanic structure with T-S fuzzy models. *Math. Comput. Simulation* 80: 402-426.
- Chen CY, Shen CW, Chen CW, Liu KFR, Jeng MJ (2009a). A Stability Criterion for Time-Delay Tension Leg Platform Systems Subjected to External Force. *China Ocean Eng.*, 23: 49-57.
- Chen PC, Chen CW, Chiang WL (2009b). GA-based modified adaptive fuzzy sliding mode controller for nonlinear systems. *Expert Syst. Appl.* 36: 5872-5879.
- Chen TH, Yang HC, Chen CY, Chen CW (2009c). Application of Logistic Regression Model: Propagation Effect on Internal Soliton. *J. Chung Cheng Institut. Technol.*, 37: 1-10.
- Chen CW, Yeh K, Liu FR (2009d). Adaptive fuzzy sliding mode control for seismically excited bridges with lead rubber bearing isolation. *Int. J. Uncertainty, Fuzziness Knowledge-Based Syst.*, 17: 705-727.
- Chen CW, Wang, Morris HL, Lin JW (2009e). Managing target the cash balance in construction firms using a fuzzy regression approach. *Int. J. Uncertainty Fuzziness Knowledge-Based Syst.*, 17: 667-684.
- Chen PC, Chen CW, Chiang WL, Yeh K (2009f). A novel stability condition and its application to GA-based fuzzy control for nonlinear systems with uncertainty. *J. Marine Sci. Technol.*, 17: 293-299.
- Chen TH, Chen CW (2010). Application of data mining to the spatial heterogeneity of foreclosed mortgages. *Expert Syst. Appl.*, 37: 993-997.
- Chen CW, Chen PC. (2010b). GA-based adaptive neural network controllers for nonlinear systems. *Int. J. Innovat. Comput. Info. Control.*, 6: 1793-1803.
- Chen CW (2010a). Modeling and fuzzy PDC control and its application to an oscillatory TLP structure. *Math. Probl. Eng. An Open Access J.*, DOI: 10.1155/2010/120403.
- Chen CW (2010b). Application of fuzzy-model-based control to nonlinear structural systems with time delay: an LMI method. *J. Vibration. Control*, 16: 1651-1672.
- Chen CY, Lin JW, Lee, W. I., Chen CW (2010a). Fuzzy control for an oceanic structure: A case study in time-delay TLP system. *J. Vibration. Control* 16: 147-160.
- Chen CY (2010c). Using discriminant analysis to determine the breaking criterion for an ISW propagating over a ridge. *Environ. Fluid Mech.* 10: 577-586.

- Chang CY, Hsu KC, Chiang KH, Huang GE (2008). Modified fuzzy variable structure control method to the crane system with control deadzone problem. *J. Vibration Control*, 14: 953–969.
- Chen CW (2010d). Fuzzy control of interconnected structural systems using the fuzzy Lyapunov method. *J. Vibration Control*, DOI: 10.1177/1077546310379625.
- Chen CW (2011d). Stability analysis and robustness design of nonlinear systems: an NN-based approach. *Appl. Soft Comput.*, 11(2): 2735-2742.
- Chen CW (2011e). Modeling, control and stability analysis for time-delay TLP systems using the fuzzy Lyapunov method. *Neural Comput. Appl.*, 20(4): 527-534.
- Chen CW, Chen CY (2010b). Are educational background and gender moderator variables for leadership, satisfaction and organizational commitment. *Afr. J. Bus. Manag.*, 4: 248-261.
- Chen CW, Chen PC, Chiang WL (2010i). Stabilization of adaptive neural network controllers for nonlinear structural systems using a singular perturbation approach. *J. Vibration Control*, DOI: 10.1177/1077546309352827.
- Chen CW, Shen CW, Chen CY, Jeng MJ (2010c). Stability analysis of an oceanic structure using the Lyapunov method. *Eng. Comput.*, 27: 186-204.
- Chen CW, Wang HL, Liu FR, Chen TH (2010f). Application of project cash management and control for infrastructure. *J. Marine Sci. Technol.*, 18: 644-651.
- Chen CW, Wang MHL, Lin JW (2009g). Managing target the cash balance in construction firms using a fuzzy regression approach. *Int. J. Uncertainty, Fuzziness Knowledge-Based Syst.*, 17(5): 667-684.
- Chen CY (2007). An experimental study of stratified mixing caused by internal solitary waves in a two-layered fluid system over variable seabed topography. *Ocean Eng.*, 34 (14-15): 1995-2008.
- Chen CY (2009c). Amplitude decay and energy dissipation due to the interaction of internal solitary waves with a triangular obstacle in a two-layer fluid system: the blockage parameter. *J. Marine Sci. Technol.*, 14 (4): 499-512.
- Chen CY (2011a). A critical review of internal wave dynamics. Part 2 – Laboratory experiments and theoretical physics. *J. Vibration Control*, DOI: 10.1177/1077546310397561.
- Chen CY (2011b). A critical review of internal wave dynamics. Part 1 – Remote sensing and in-situ observations. *J. Vibration Control*, DOI: 10.1177/1077546310395971.
- Chen CY (2011c). Statistical and dynamical analyses of propagation mechanisms of solitary internal waves in a two-layer stratification. *J. Marine Sci. Technol.*, 16 (1): 100-114, DOI 10.1007/s00773-010-0112-z.
- Chen CY (2011f). A critical review and improvement method on biped robot. *Int. J. Innovative Comput. Info. Control*, 7(9): 5245-5254.
- Chen CY, Hsu, John RC, Cheng MH (2007g). Laboratory observations on internal solitary wave evolution on steep and inverse uniform slopes. *Ocean Eng.*, 34 (1): 157-170.
- Chen CY, Hsu, John RC, Cheng MH (2007h). An investigation on internal solitary waves in a two-layer fluid: propagation and reflection from steep slopes. *Ocean Eng.*, 34 (1): 171-184.
- Chen CY, Huang PH (2011). Review of an autonomous humanoid robot and its mechanical control. *J. Vibration and Control*, DOI: 10.1177/1077546310395974.
- Chen CY, Lee WI, Kuo HM, Chen CW, Chen KH (2010d). The study of a forecasting sales model for fresh food. *Expert Syst. Appl.*, 37: 7696-7702.
- Chen CY, Liu KC, Liu YW, Huang WC (2010h). A case study of reinforced concrete short column under earthquake using experimental and theoretical investigations. *Struct. Eng. Mech.*, 36: 197-206.
- Chen CY, Shih BY, Chen ZS, Chen TH (2011e). The exploration of internet marketing strategy by search engine optimization: A critical review and comparison. *Afr. J. Bus. Manag.*, 5(12): 4644-4649.
- Chen CY, Shih BY, Chou WC (2011a). The development of autonomous low cost biped mobile surveillance robot by intelligent bricks. *J. Vibration Control*, DOI: 10.1177/1077546310371349.
- Chen CY, Shih BY, Chou WC (2011b). The development of autonomous low cost biped mobile surveillance robot by intelligent bricks. *J. Vibration and Control*, DOI: 10.1177/1077546310381101.
- Chen CY, Shyue SW, Chang CJ (2010g). Association rule mining for evaluation of regional environments: Case study of Dapeng Bay, Taiwan. *Int. J. Innovative Comput. Info. Control*, 6: 3425-3436.
- Chen CY, Yang YF, Chen CW, Chen LT, Chen TH (2010e). Linking the balanced scorecard (BSC) to business management performance: A preliminary concept of fit theory for navigation science and management. *Int. J. Phys. Sci.*, 5: 1296-1305.
- Chen PC, Chen CW, Chiang WL (2011d). Linear matrix inequality conditions of nonlinear systems by genetic algorithm-based adaptive fuzzy sliding mode controller. *J. Vibration Control*, 17(2): 163-173.
- Chen PC, Chen CW, Chiang WL, Lo DC (2011c). GA-based decoupled adaptive FSMC for nonlinear systems by a singular perturbation scheme. *Neural Computing and Applications* 20(4): 517-526.
- Chiang WL, Chiou DJ, Tang JP, Hsu WK, Liu TY (2010). Detecting the sensitivity of structural damage based on the Hilbert-Huang transform approach. *Eng. Comput.*, 27: 799-818.
- Chin WW, Marcolin BL, Newsted PR (2003). A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study. *Info. Syst. Res.*, 14(2): 189 - 217.
- Davis FD (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.*, 13(3): 319-340.
- Davis FD, Bagozzi RP, Warshaw PR (1989). User Acceptance of Computer Technology: a Comparison of Two Theoretical Models. *Manage. Sci.*, 35(8): 982-1003.
- Fornell C, Bookstein FL (1982). "Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory." *J. Market. Res.*, 19: 440-452.
- Hsiao FH, Chen CW, Liang YW, Xu SD, Chiang WL (2005e). T-S Fuzzy Controllers for Nonlinear Interconnected Systems with Multiple Time Delays. *IEEE Trans. Circuits Systems-IRegular Papers* 52: 1883-1893.
- Hsiao FH, Chen CW, Wu YH, Chiang WL (2005a). Fuzzy Controllers for Nonlinear Interconnected TMD Systems with External Force. *J. Ch. Institu. Eng.*, 28: 175-181.
- Hsiao FH, Chiang WL, Chen CW (2005d). Fuzzy Control for Nonlinear Systems via Neural-Network-Based Approach. *Int. J. Computat. Methods Eng. Sci. Mech.*, 6: 145- 152.
- Hsiao FH, Chiang WL, Chen CW, Xu SD, Wu SL (2005c). Application and Robustness Design of Fuzzy Controller for Resonant and Chaotic Systems with External Disturbance. *Int. J. Uncertainty, Fuzziness and Knowledge-Based Syst.*, 13: 281-295.
- Hsiao FH, Hwang JD, Chen CW, Tsai ZR (2005b). Robust Stabilization of Nonlinear Multiple Time-Delay Large-scale Systems via Decentralized Fuzzy Control. *IEEE Trans. Fuzzy Syst.* 13: 152- 163.
- Hsieh TY, Wang MHL, Chen CW (2006). A New Viewpoint of S-Curve Regression Model and its Application to Construction Management. *Int. J. Artificial Intelligence Tools*, 15: 131-142.
- Lee SC, Lin PH, Wang JS, Huang CH, Chen CY, Huang PH (2011b). Mass media in Taiwan and the formation of Chien-Ming Wang's baseball superstar image. *Int. J. Phys. Sci.*, 6: 3000-3006.
- Lee SC, Wang CC, Huang CC, Wang JS, Huang CH, Chen CY, Huang PH (2011a). The idolization of Chien-Ming Wang and social psychological factors in Taiwan. *Int. J. Phys. Sci.*, 6: 2607-2612.
- Lee WI, Chen CW, Chen TH, Chen CY (2010a). The relationship between consumer orientation, service value, medical care service quality and patient satisfaction: The case of a medical center in Southern Taiwan. *Afr. J. Bus. Manag.*, 4: 448-458.
- Lee WI, Chen CW, Wu CH (2010b). Relationship between quality of medical treatment and customer satisfaction - a case study in dental clinic association. *Int. J. Innovative Comput. Info. Control*, 6: 1805-1822.
- Lee WI, Chiu YT, Liu CC, Chen CY (2011c). Assessing the effects of consumer involvement and service quality in a self-service setting. *Human Factors and Ergonomics in Manufacturing and Service Industries*, DOI: 10.1002/hfm.20253.
- Legris P, Ingham J, Colletette P (2003). Why do People Use Information Technology? Critical Review of the Technology Acceptance Model. *Info. Manag.*, 40: 191-204.
- Lin CL, Wang JF, Chen CY, Chen CW, Yen CW (2009b). Improving the generalization performance of RBF neural networks using a linear

- regression technique. *Expert Syst. Appl.*, 36: 12049-12053.
- Lin ML, Chen CW (2010). Application of fuzzy models for the monitoring of ecologically sensitive ecosystems in a dynamic semi-arid landscape from satellite imagery. *Eng. Comput.*, 27: 5-19.
- Lin ML, Chen CW, Wang QB, Cao Y (2009a). Fuzzy model-based assessment and monitoring of desertification using MODIS satellite imagery. *Eng. Comput.*, 26: 745-760.
- Ormrod JE (2006). *Educational Psychology: Developing Learners* (5th ed.). "glossary". N.J., Merrill: Upper Saddle River (companion website).
- Pijpers G (2001). Executives' Use of Information Technology: An Examination of Factors Influencing Managerial Beliefs, Attitude and Use of Information Technology. *Info. Software Technol.*, 43(15): 959-971.
- Plouffe CR, Hulland JS, Vandenbosch M (2001). Research Report: Richness Versus Parsimony in Modeling Technology Adoption Decisions - Understanding Merchant Adoption of a Smart Card-Based Payment Systems. *Info. Syst. Res.*, 12(2): 208-222.
- Shih BY, Chang CJ, Chen AW, Chen CY (2010c). Enhanced MAC Channel Selection to Improve Performance of IEEE 802.15.4. *Int. J. Innovative Comput. Info. Control* 6: 5511-5526.
- Shih BY, Chen CY, Chang H, Ma JM (2011b). Dynamics and control for robot manipulators using a greedy algorithm approach. *J. Vibration Control*, DOI: 10.1177/1077546311407649.
- Shih BY, Chen CY, Chou WC (2011). Obstacle avoidance using a path correction method for autonomous control of a biped intelligent robot. *J. Vibration and Control*, DOI: 10.1177/1077546310372004.
- Shih BY, Chen CY, Chou WC (2011a). Obstacle avoidance using a path correction method for autonomous control of a biped intelligent robot. *J. Vibration Control*, DOI: 10.1177/1077546310372004.
- Shih BY, Chen CY, Li CE (2010d). The exploration of mobile mandarin learning system by the application of TRIZ theory. *Comput. Appl. Eng. Edu.*, DOI : 10.1002/cae.20478.
- Shih BY, Chen CY, Shih CH, Tseng JY (2010a). The development of enhancing mechanisms for improving the performance of IEEE 802.15.4. *Int. J. Phy. Sci.*, 5: 884-897.
- Shih BY, Lee WI, Chen CY (2011d). A hybrid artificial intelligence sales-forecasting system in the convenience store industry. *Human Factors and Ergonomics in Manufacturing and Service Industries*, DOI: 10.1002/hfm.20272.
- Shih CH, Wakabayashi N, Yamamura S, Chen CY (2011c). A context model with a time-dependent multi-layer exception handling policy. *Int. J. Innovative Comput. Info. Control.*, 7(5A): 2225-2234.
- Shih CH, Yamamura S, Chen CY (2010b). Analysis of control structure for turning maneuvers. *Mathematical Problems in Eng.* 2010, DOI:10.1155/2010/481438.
- Taylor S, Todd P (2001). Understanding Information Technology Usage: A Test of Competing Models. *Info. Res.* 6(2): 144-176.
- Trabia MB, Renno JM, Moustafa KAF (2008). Generalized design of an anti-swing fuzzy logic controller for an overhead crane with hoist. *J. Vibration Control*, 14: 319-346.
- Tsai CH, Chen CW, Chiang WL, Lin ML (2008). Application of Geographic Information System to the Allocation of Disaster Shelters via Fuzzy Models. *Engineering Computations. Int. J. Comput. Aided Eng. Software*. 25: 86-100.
- Tu JW, Qu WL, Chen J (2008). An experimental study on semi-active seismic response control of a large-span building on top of ship lift towers. *J. Vibration. Control* 14: 1055-1074.
- Vallerand RJ (1997). *Toward a Hierarchical Model of Intrinsic and Extrinsic Motivation*. New York: Academic Press.
- Venkatesh V, Davis FD (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Manag. Sci.*, 46(2): 186-204.
- Venkatesh V, Morris M, Davis G, Davis FD (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Q.*, 27(3): 425-478.
- Yang CH, Chen TH, Chen CW, Chen CY, Liu CT (2008b). Accuracy evaluation of a diagnostic test by detecting outliers and influential observations. *China Ocean Eng.*, 22: 421-429.
- Yang HC, Chen CY, Chen CW, Chen TH (2008a). Estimation on internal wave reflection in a two-layer fluid system by cumulative logistic regression model. *J. Marine Sci. Technol.*, 16: 44-51.
- Yeh K, Chen CY, Chen CW (2008). Robustness Design of Time-Delay Fuzzy Systems Using Fuzzy Lyapunov Method. *Appl. Math. Comput.*, 205: 568-577.
- Yildirim S, Erkaya S, Eski I, Uzmay I (2009). Noise and vibration analysis of car engines using proposed neural network. *J. Vibration Control* 15: 133-156.
- Zhao FG, Chen J, Guo L, Li X (2009). Neuro-fuzzy based condition prediction of bearing health. *J. Vibration Control*, 15: 1079-1091.