Abstract—The study has modified UTAUT (Venkatesh et al., 2003) to determine technology acceptance of web-based learning system of Taiwan technical university students. This study used cluster sampling and stepwise regression analysis to determine the relationships among constructs. Research results showed that performance expectancy, attitude toward using technology, facilitating conditions, self-efficacy, and social influence have significant influence on behavior intention. Additionally, only behavior intention, attitude toward using technology, and social influence have direct impact on system usage.

Index Terms—web-based learning, e-learning, learning system, technology acceptance, UTAUT

I. INTRODUCTION

In educational setting, Information technology (IT) has begun gradually to play an indispensable role. Applying IT in instruction can change education significantly [1][2]. The adoption of IT can also improve students’ learning, problem solving and creativity [3]. Web-based learning system such as WebCT, Blackboard, or Moodle has been widely adopted by many educational institutions for online course-building [4]. According to Allen and Seaman [5], around 90% of all public institutions have provided online courses at the postsecondary level.

II. LITERATURE REVIEW

A. Web-based learning systems

A Web-based learning system allows instructors to create individualized web pages based on students’ competencies and students can control the phase of a course according to their learning abilities. As opposed to instructional television (ITV) that is able to deliver audio and video, the most common form of Web-based learning is text-based asynchronous learning [6]. Asynchronous learning has the advantage of flexibility in time and location for both instructors and learners. They are not required to be present in the system at the same time. Once connected to the Internet with access to the learning system, students can learn from anywhere in the world at any time. The disadvantage of asynchronous learning is that the interaction among instructor and students might not be as effective as face-to-face instruction because they are not able to communicate with each other directly [7].

Due to increase of Internet bandwidth and advance of Information Technology, web-based learning system is now capable of integrating media of many different types including text, graphic, audio, and video. Real time functions such as chat, online lectures, or online assessments have been integrated into web-based learning system to enable online learning [8][9]. Users have control over or interact with the system.

The purpose of adopting Web-based learning system is not only to improve learning effectiveness and efficiency, but also to provide an alternative approach in instruction. Altekruse and Brew [10] pointed out that Web-based instruction is not capable of duplicating the live instructor, but would probably be second best to face-to-face instruction. McArthur, Parker, and Giersch [11] believed that use of online functions can enhance traditional teacher-centered courses. Some studies even showed that students in e-learning outperformed those in traditional classes [12][13]. Nanayakkara [14] has found that release time, the ease of use, perceived usefulness, training and support, and reliability are the five most essential factors for e-learning systems. Though web-based learning is increasingly common in tertiary education [15], Hill [16] suggested that new users who first received Web-based instruction might have the need for more initial training and more feedback. It must be prevented that technology used in the classroom sometime was unrelated or even became a barrier to a course [17].

B. Technology acceptance theories and UTAUT

Users’ acceptance of Information Technology (IT) is a precondition before users can recognize IT’s value and then utilize it [18]. As early as mid-1980s, many models or theories tried to explain users’ technology acceptance have been proposed and widely discussed. The most important ones are the Theory of Reasoned Action (TRA) [19], the Technology Acceptance Model (TAM) [20], the Theory of Planned Behavior (TPB) [21], the extended technology acceptance model (TAM2) [22], and the most recent Unified Theory of Acceptance and Use of Technology (UTAUT) [23].

Theories like TAM, TPB and UTAUT are all originated from TRA, which explain human behavior from social psychology’s view point. TRA was very general in nature and tried to explain almost any human behavior. TRA suggests that social behavior is motivated by an individual’s attitude toward carrying out that behavior. An individual’s actual behavior can be
predicted by behavior intention, which is determined by both the attitude towards a specific behavior and subjective norm concerning the behavior in question. In other words, behavior is the result of one’s beliefs about the outcomes of performing that behavior after evaluating each of those outcomes.

TAM (Figure 1) adopts TRA’s causal linkages, a sequence of beliefs, attitudes, intentions, and behaviors, to explain the individual’s IT acceptance behaviors. In TAM, perceived usefulness (PU) and perceived ease of use (PEOU) are hypothesized as fundamental determinants of user acceptance of a given IT. Davis (1989) defined perceived usefulness as “the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context” (p.985) and perceived ease of use as “the degree to which the prospective user expects the target system to be free of effort” (p. 985). PU and PEOU have a direct influence on an individual’s attitudes toward the use of IT. An individual’s attitude impacts one’s behavioral intentions to use IT. Behavioral intentions, in turn, directly affect actual IT usage.

In TAM2 (Figure 2), an extended TAM, social and organizational variables such as subjective norm, image, job relevance, output quality, and result demonstrability were included in the model. All these factors have direct impact on PU. In addition, subjective norm not only influence PU, but also affect user intention. Either TAM or TAM2 has been widely adopted to explain individual’s technology acceptance in various consumer or organization settings [24].

TAM is the first and the most influential research models in studies of the determinants of IT or Information System acceptance. The model is empirically proven successful in predicting about 40% of a system’s use[25]. However, a meta-analysis performed by Legris, Ingham and Collerette [26] pointed out three shortcomings of TAM research to date. First, nine out of 22 TAM studies involved students. They argued that it would be better if the research had been conducted in a business environment. Secondly, most studies examined the introduction of office automation software or system development applications. It would be beneficial if the research examined the introduction of business process applications. Third, most studies did not measure system use intended in TAM but measured the variance of self-reported use instead. Self-reported use should serve as a relative indicator only.

After reviewing 8 technology acceptance theories, Venkatesh [23] proposed UTAUT (Figure 3) which consists of four constructs, performance expectancy, effort expectancy, social influence, and facilitating conditions, that have direct impact on behavior intention and usage. UTAUT is the best model so far to predict individual’s technology acceptance because it can explain 70% of depend variable variance comparing with TAM only 40%. In UTAUT, performance expectancy is similar to TAM’s perceived usefulness, and is defined as “the degree to which an individual believes that using the system will help him or her to attain gains in job performance”. Like perceived ease of use in TAM, effort expectancy is refers to “the degree of ease associated with the use of the system”. Social influence is “the degree to which an individual believes that important others believe he or she should use the new system”. Social influence refers to “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system”.

Unlike TAM, UTAUT introduced 4 moderators. There are gender, age, experience, and voluntariness of use. These factors can help to explain the behavior differentiation on different relationships. For example, the effect of performance expectancy on behavior intention is moderated by gender, age, and experience. The effect of effort expectancy on behavior intention is moderated by gender, age, and experiences. The effect of social influence on behavior intention is moderated by all 4 variables while the effect of facilitating conditions on use behavior is moderated by age and experience, 2 variables only.
III. THE RESEARCH

A. Research model

Seven constructs that have direct impact on user intention or usage [23] will be included in the initial research model. These constructs are performance expectancy, effort expectancy, attitude toward using technology, facilitating conditions, self-efficacy, social influence, and anxiety. Proposed research model is shown as Figure 4.

B. Population and sample

The target population contained all postsecondary students who take e-learning classes and were enrolled technical universities in Taiwan during the spring semester of 2009.

Cluster sampling was used to select students in the study. Samples were collected from 4 technical universities located in northern, middle, and southern Taiwan. In total, there were 22 classes of students who were over 18 years old and from different academic majors, such as Management Information Systems, Healthcare Administration, and Pharmacy, participated in this study.

C. The survey instrument

An initial survey instruments with 23 questions was developed based upon the work of Venkatesh et. al. [23]. The questionnaire contains 2 questions each for variables such as performance expectancy, effort expectancy, attitude toward using technology, facilitating conditions, self-efficacy, anxiety, behavior intention, and system usage. Remaining 5 questions are for moderators such as gender, computing skills, computer ownership, accessibility outside campus, and frequency of using Internet.

Fifty two students participated a pilot study to assure the reliability and validity of the instrument. Questions for testing facilitating conditions and self-efficacy were removed from the questionnaire due to their low alpha coefficients. Finally, there are 19 questions in the questionnaire.

D. Instrument Validity and Reliability

Validity is the strength of conclusions, inferences, or propositions. More formally, Cook and Campbell (1979) defined it as the "best available approximation to the truth or falsity of a given inference, proposition, or conclusion" (Trochim, 1991, p. 33). The questions in the survey instruments were sifted from items selected by Venkatesh et. al. [23] to estimate UTAUT. Thus, validity of the survey instrument has been established.

Reliability is the consistency of the measurement or the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. Reliability of the instrument may be measured by test/retest or internal consistency. Internal consistency can be determined by the procedure developed by Cronbach (1951). Cronbach's alpha splits all the questions in the instrument every possible way and computes correlation values for them all. Alpha coefficients for all the constructs ranged from .768 to .878, all well above the .70 standard of reliability as suggested by Nunnally and Bernstein (1994). The reliability for the survey instruments as a whole is .860. Thus, internal consistency of the instrument was determined.

E. Data analysis

A total of 606 valid surveys were collected. The statistical methods of stepwise regression analyses were performed to check the effects among various constructs. SPSS 15 and AMOS 7 were used to perform all statistical analysis.

IV. FINDINGS

A. Analysis of the research model

A series of stepwise regression analyses were performed to examine the effects of performance expectancy, effort expectancy, attitude toward using technology, facilitating conditions, self-efficacy, social influence, and anxiety on the behavior intention and system usage. The results indicated that performance expectancy, attitude toward using technology, facilitating conditions, self-efficacy, and social influence can predict behavior intention. The analysis of variance shows that the model is significant, F(5, 575) = 78.72, p = .000. The coefficient of determination (R²) was computed as .406 and the adjusted R² was .401, indicating that the regression model accounted for 40.1% of the total variance in behavior intention.

In addition, behavior intention, attitude toward using technology, and social influence can predict system usage. The analysis of variance shows that the model is significant, F(3, 577) = 214.25, p = .000. The coefficient
of determination ($R^2$) was computed as .527 and the adjusted $R^2$ was .524, indicating that the regression model accounted for 52.4% of the total variance in system usage. The result of research is shown as Figure 5.

V. DISCUSSION AND CONCLUSIONS

The study has modified UTAUT (Venkatesh et al., [23] to determine technology acceptance of web-based learning system of Taiwan technical university students. Performance expectancy, attitude toward using technology, facilitating conditions, self-efficacy, and social influence have significant influence on behavior intention. Additionally, only behavior intention, attitude toward using technology, and social influence have direct impact on system usage.

Except for the influence of constructs on system usage, the final model differs from UTAUT in 2 ways. First, effort expectancy was not included in the final model. Second, attitude and self-efficacy reenter the final model. The researcher believes that the differences are caused mainly by different experimental setting. The study sampled students enrolled in distance courses from different schools while Venkatesh et. al. sampled IT users from different organizations.

Hindes’s [27] studied regarding a Web-based course indicated that participants’ attitudes toward Web-based instruction are positive, and Web-based instruction provides a learning environment for participants to develop electronic literacy skills and share their ideas and projects. Individual reasons such as negative attitudes could influence the technology use in the classroom [28]. These studies indicated that student attitude have positive impact on both behavior intention and actual usage of web-based learning system.

Due to time constrain, the effect of moderators on constructs were not discussed in the paper. Future research should explore the influence of gender, computing skills, computer ownership, accessibility outside campus, and frequency of using Interne on the model.

REFERENCES


