

Exploring Factors Influencing Nurse's Intention to Use a Technology-Mediated Training System

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ABSTRACT: This study proposes a conceptual model that investigates the factors affecting nurses' behavioral intention to use a Blended E-Learning System (BELS). We integrated motivation, the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM) to create a theoretical model to explain and predict the intentions of learners to use BELS. Additionally, in the research model, motivation is proposed as a formative second-order construct driven by intrinsic motivation. Self-reporting questionnaires were distributed to local community hospitals, regional hospitals, and medical centers in Taiwan. Among the 589 distributed questionnaires, we received 528 valid responses, yielding a response rate of 89.64%. Using structural equation modeling (SEM), the results indicated that perceived usefulness, attitude, and subjective norms influence behavioral intentions toward BELS. Perceived ease of use, perceived usefulness, and motivation considerably affect attitudes related to use. The present study demonstrated that the two antecedents, intrinsic and extrinsic of motivation, are crucial components of motivation. This study concludes with a discussion on the limitations of the study, and its implications in further research and practice.

KEYWORDS: Blended e-learning system (BELS), formative model, motivation.

1 INTRODUCTION

With the development of the Internet and information technology, numerous educational and training institutions, universities, enterprises, and hospitals are investing substantial amounts in developing e-learning courses [1]. Although the advantages of e-learning for individual learning or cooperative learning include usage flexibility, no space limitations, and increased convenience and efficiency [3]. Conversely, there are also some disadvantages, such as lack of communication and interaction between peers, expensive multimedia materials, system maintenance and update costs [2], [3]. In response to learners' concerns regarding e-learning and the challenges that various learning methods generate, educational workers regard using a blended e-learning system (BELS) as effective alternative teaching method [4].

In recent years, several universities have adopted BELS as on-campus e-learning platforms [3], [5], [6]. Using this platform, several learning methods are integrated, including face-to-face learning in class, simultaneous e-learning, and indirect e-learning. Not only can learners experience face-to-face learning but also use online learning materials. Learners can use functions in the BELS for mutual cooperative learning. However, learners consistently use BELS that will influence the behavioral intentions of use. Njenga and Fourie [7] claimed that e-learning platforms can promote the construction of cooperative learning and relationship establishment. Lin and Wang [6] noted that e-learning platforms can assist learners in collecting, constructing, and sharing knowledge. Wu et al. [2] asserted that to facilitate the efficient use of BELS, individual psychological factors (i.e., individual motivations, attitudes, and levels of use of information technology (IT)) and technical factors (i.e., course designs) should be considered and the influences that these factors exert on behavioral intentions should be investigated. Therefore, this study investigated how the innovation of IT affects learners' BELS behavioral intentions from the perspective of learners' psychological factors (individual motivation to and attitude toward using IT).

This study integrated motivation, the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM) to develop a new model and explain learners' intention of use for BELS. The following reasons explain why these theories were integrated: The behavioral intention of users who adopt IT is influenced by individual subjective norms [8]. In addition, learners might exhibit usage behavior toward new technology but lack the necessary skills to use it, such as perceived behavioral control (PBC) [9]. TPB can be used to eliminate the aforementioned differences and apply the influences of individual and organizational systems to explain the adoption of new technology. Although behavioral intentions are influenced by individuals, organizational systems, and societies, the influence that attitude beliefs exert on the attitudes of learners who use e-learning has not been investigated in the TPB [10]. Taylor and Todd [11] observed that the TAM provides two attitude beliefs: perceived ease of use and perceived usefulness, which are crucial antecedent variables that affect attitudes in the TAM. In addition, the new learning environments and techniques provided by BELS are typically voluntarily used by learners. However, medical personnel's individual learning motivation also influences BELS usage.

The BELS investigated in this study was integrated with face-to-face teaching and online teaching. Learners can study teaching material and obtain relevant course information such as course assignments and other discussion questions. Numerous studies relevant to information system usage models have been conducted; however, these studies have not included a fixed model standard and a defined usage environment. Verifying and comparing the behavior patterns adopted in previous related studies to identify the optimal models for BELS learning environments can determine the causal relationship between learners and BELS behavioral intentions and decrease predicted costs and risks. Although BELS usage has been investigated in previous studies [2], [6], motivation, the TPB, and the TAM have not been combined. Therefore, this study integrated these three concepts to explain the BELS behavioral intentions of nurses and empirically evaluate crucial factors affecting behavioral intentions. The results of this study furthered studies on learners and BELS. In addition, structural equation modeling (SEM) was used to construct the BELS behavioral intention relationship model for nurses and verify whether the model is suitable for application in e-learning among nurses.

The remainder of the paper is organized as follows: Section 2 reviews the theoretical foundations of motivation, the TAM, and the TPB. Based on a critical review of the literature, we propose a theoretical framework and research hypotheses for nurses. Section 3 specifies the research design used in this study, and explains the scale source, sample frame, measurement instrument, data, and data processing used in detail. Section 4 provides the data analysis and results of SEM. Finally, in Section 5, the implications and discussion of the results, the drawn conclusions, limitations of the study and future research directions are presented.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Based on past research, this paper introduces a conceptual framework for further research, illustrated in Fig. 1. The following section provides a discussion on the theoretical bases and development of the hypotheses.

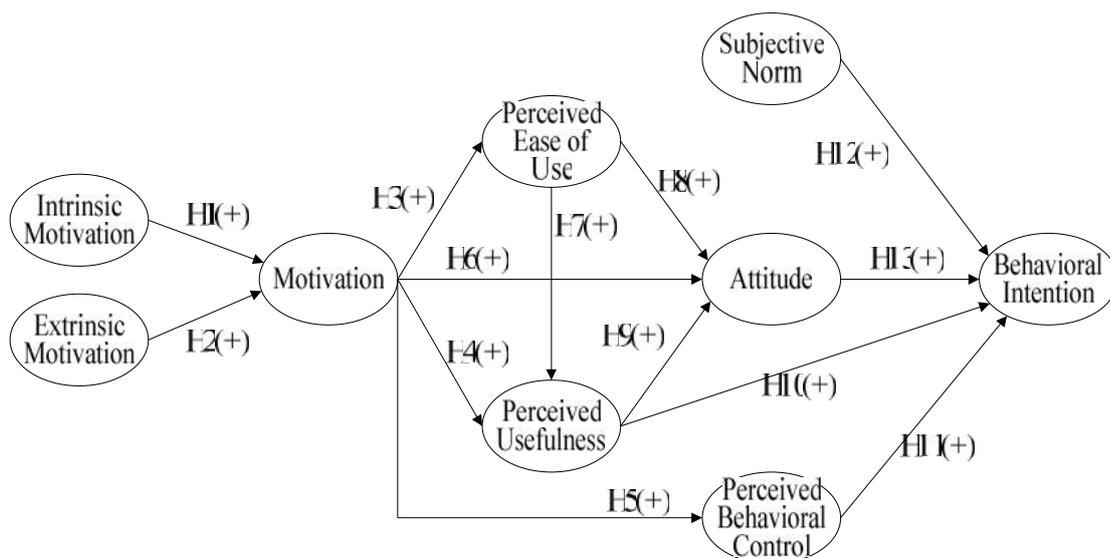


Fig. 1. Research model

2.1 MOTIVATION

Cognitive evaluation theory has been proven to affect personal intention and behaviors [13]. Researchers Senecal, et al. [14] have broadly divided motivation into intrinsic motivation and extrinsic motivation. Deci, et al. [13] and George and Brief [15] indicated that motivation is the key factor in recognizing a person's general or working behavior and it positively influences whether a person continues engaging in certain behavior. The importance of studying motivation is that it facilitates the understanding of how human beings are stimulated and how they maintain or terminate motivations. The study of motivation is a complicated intrinsic property. People can observe the effect of stimulations by using various approaches. A person can be stimulated or motivated by distinct factors depending on the place or context in which the person is located. However, Pierce, et al. [16] argued that extrinsic motivation refers to the involvement of an individual in an activity; for example, a person accesses new technology because of their own interest, satisfaction, happiness, preference, or any other emotions, without external pressure or incentives. Deci, et al. [17] considered extrinsic motivation as an individual being motivated by external and tangible things, such as remuneration and rewards, to engage in activities.

When a person is intrinsically [18], [19] or extrinsically [17] stimulated while engaging in a certain activity and the stimulation continues, extrinsic motivation reduces the person's intrinsic motivation [18], [20]. In the study of the motivations of individuals to use technology or computer technology, Davis [21] reported that practicality can be a motivation. In addition, the researcher addressed the significance of intrinsic and extrinsic motivations and noted that when a user becomes more experienced in using a computer training system, during the process of using the system, intrinsic and extrinsic motivations play a role in self-regulation and form new stimulations that encourage the user to adopt new IT. Therefore, Deci, et al. [17] stated that motivations are multidimensional latent variables. Furthermore, intrinsic and extrinsic motivations can be measured separately by using measurement items. To improve the explanatory power of motivations as latent variables in this study, motivation was considered to be a formative indicator, and intrinsic and extrinsic motivations were considered as reflective indicators. Therefore, six hypotheses are proposed:

- H1: Intrinsic motivation positively affects the motivation for BELS.
- H2: Extrinsic motivation positively affects the motivation for BELS.
- H3: Motivation positively affects the perceived ease of use for BELS.
- H4: Motivation positively affects the perceived usefulness for BELS.
- H5: Motivation positively affects the PBC for BELS.
- H6: Motivation positively affects the attitude toward using BELS.

2.2 TECHNOLOGY ACCEPTANCE MODEL (TAM) AND THEORY OF PLANNED BEHAVIOR (TPB)

Davis [21] proposed the TAM, which is an extension of the theory of reasoned action (TRA) [8]; the TAM superiorly explains learners' acceptance behaviors. Both the TPB and TAM were formed based on the TRA [8] and assert that behavioral attitudes and subjective norms affect behavioral intentions, and behavioral intention influences actual behaviors. TPB contains one more element than the TRA does, which is PBC. PBC influences behavioral intentions and actual behaviors [9]. The TAM suggests that perceived ease of use and perceived usefulness are two crucial factors influencing technology acceptance. The TAM has been applied to investigate learners' acceptance of various new technologies, such as e-mail, the Internet, health care, medical education, and e-learning [1], [6], [21], [22], [23].

BELS learners should consider BELS as a practical tool and use it to enhance personal learning efficiency and communication with colleagues, friends, and others. Therefore, BELS learners should regard the system as convenient. In addition, the TAM emphasizes that perceived usefulness directly influences learners' behavioral intentions. Perceived ease of use indirectly influences behavioral intentions through perceived usefulness [21]. In other words, perceived usefulness mediates the influence of perceived ease of use on behavioral intention, and several empirical studies have supported this argument [1], [10], [23], [24]. In summary, the following hypotheses are proposed:

- H7: Perceived ease of use positively affects the perceived usefulness of BELS.
- H8: Perceived ease of use positively affects the attitude toward using BELS.
- H9: Perceived usefulness positively affects the attitude toward using BELS.

In exploring the intention of using information systems, Lee [1] and Wu et al. [23] determined that both the TPB and TAM have acceptable explanatory power. The difference between TPB and TAM is that the TAM is a simplified model, and is used to investigate information systems. The TAM indicates that potential users' attitude toward an information system is

mainly affected by perceived ease of use and perceived usefulness, whereas TPB claims that whether potential users access an information system depends on social variables and the behavior control of users. Lee [1] indicated that although the intention of using e-learning systems is categorized as information system usage, if it is only measured using the TAM, the influence of social pressure would be overlooked. If the intention to use is predicted using only TPB, users' control over e-learning systems would be ignored. In addition, unlike the TAM, TPB is not designed to investigate the use of information systems. Therefore, this study combines the two theories to predict users' intention of using e-learning systems. Thus, four hypotheses are proposed:

- H10: Perceived usefulness positively affects the behavioral intention to use BELS.
- H11: PBC positively affects the behavioral intention to use BELS.
- H12: Subjective norms positively affect the behavioral intention to use BELS.
- H13: Attitude positively affects the behavioral intention to use BELS.

3 METHODOLOGY

3.1 QUESTIONNAIRE DEVELOPMENT

This study involved two main goals. The first was to construct a theoretical model to predict and explain the behavioral intention to use BELS, and conduct an empirical evaluation of the factors that are critical to behavioral intention. The second goal was to test the empirical model. The purpose of this study was to employ motivation, the TAM, and the TPB to investigate their interrelation with the behavioral intention to use BELS.

We used a questionnaire survey comprising two parts to test the proposed theoretical model. The first part contained questions used to measure the constructs included in the research model, whereas the second part contained participant demographic questions. All items were measured using a five-point Likert-type scale, with answer choices ranging from "strongly agree" (5) to "strongly disagree" (1), and most of these items were adapted from the extant literature. To reduce potential ceiling (or floor) effects, we induced monotonous responses to the items that were designed to measure the constructs.

The scale used in this study was developed following the recommendations and the standard psychometric scale development procedures presented by Devellis [25] and Straub et al. [26]. The scale items for motivation (intrinsic motivation and extrinsic motivation) were adapted from Deci, et al. [13], George and Brief [15], and Pierce et al. [16]; the items of perceived ease of use, perceived usefulness, attitude, and behavioral intention were adapted from the TAM scale [1], [21], [24]. In addition, the items used to measure subjective norm and PBC were adapted from the TPB scale [1], [11], [12].

To ensure that the survey questionnaire was concise and understandable, we conducted an in-depth interview and a pilot study. First, the initial questionnaires were administered to five researchers who were experts on e-learning or were interested in IT and information systems. The questionnaire was revised according to their comments and suggestions to make the wording of the items more precise. In addition, the face and content validity of the instrument was verified based on the interview, and the generation of constructs was based on an extensive study of the extant literature in related fields such as e-learning, motivation, the TAM, the TPB, and the adaptation of measurement items that have been validated in previous empirical studies.

Subsequently, we administered the initial questionnaire to 60 subjects comprising nurses who worked in medical institutions and had taken BELS courses. The Cronbach's alpha reliability scores ranged from 0.714 for perceived ease of use to 0.939 for behavioral intention. This result implies that the scales used in this study satisfactorily measured the constructs. Based on the pilot study results, we revised the questionnaire two times. The final survey included 35 items and a series of demographic and self-reported use items.

3.2 SAMPLE

To fulfill the research objectives, we used mail and interview surveys. The research participants were nurses from nine target hospitals (including medical centers, regional hospitals, and district hospitals) in Taiwan who had taken BELS courses. As a preliminary step, we recruited a local contact for each target hospital to administer the questionnaire. We conducted interview surveys in the nursing department of the hospitals that were willing to participate in the study. If the hospitals were unable or unwilling to distribute the surveys, we used mail surveys. All the participants were volunteers.

A total of 589 questionnaires were distributed to nurses who had used e-learning systems. Sixty-one responses that were returned questionnaires with incomplete or invalid answers were eliminated, and 528 valid responses were received. All the valid responses were used for statistical analysis and a valid response rate of 89.64% for the initial sample was achieved. Among the valid responses, 175 responses were gathered from a local community hospital, 305 were collected from regional hospitals, and 48 were obtained from major medical centers. Regarding demographics, the mean age was 33.59 y (standard deviation (SD) = 7.45 y). Regarding the education level of the sample population, 27 (5.1%) had received a degree from a nursing college, 488 (92.4%) had received a college education, and 13 (2.5%) had a master’s degree. Regarding the nursing level of the sample population, 221 (41.9%) had a level of N1, 204 (38.6%) had a level of N2, 74 (14.0%) had a level of N3, and 29 (5.5%) had a level of N4.

Table 1. Profiles of Respondents (N=528)

Factor/ Level	N	%
Formal Education		
Nursing College	27	5.1
Faculty degree/ bachelor degree	488	92.4
Master degree or above	13	2.5
Type of Hospital		
Medical centers	48	9.1
Regional hospitals	305	57.8
Local hospitals	175	33.1
Levels of Nursing		
N1	221	41.9
N2	204	38.6
N3	74	14.0
N4	29	5.5

4 RESULTS

The most common SEM techniques used are linear structural relations (LISREL), partial least-squares (PLS), and analysis of moment structures. LISREL is a covariance-based SEM technique that involves the use of a maximum likelihood function to obtain estimators in models. PLS is component based and involves the use of a least-squares estimation procedure. PLS is an increasingly and commonly used method for analyzing the SEM [27], and has several advantages: (1) a small sample; (2) increased prediction ability; (3) a high number of constructs and/or indicators; (4) few demands on residual distributions; (5) and theories are tested at the early stages of development [28], [29]. To verify the hypotheses, we used PLS technology for data analysis. This technique can be used to analyze both a structural model (assessing relationships among theoretical constructs) and a measurement model (assessing the reliability and validity of measures).

4.1 MEASUREMENT VALIDITY

The relationships between the observed variables (i.e., manifest variables or indicators) and the latent variables (i.e., constructs being measured) are specified by the measurement model. The convergent and discriminate construct validity were both provided to verify the construct measures [30]. Convergent validity refers to the consistency that multiple items exhibit in measuring the same construct. Three criteria were used for assessing convergent validity [31], [32], [33]: (1) reliability coefficients (Cronbach’s alpha coefficients) should be greater than 0.60; (2) the composite reliability coefficients for each latent construct should be greater than 0.70; and (3) the average variance extracted (AVE) for each latent construct should exceed 0.50.

We assessed internal consistency by using Cronbach’s alpha coefficients and the composite reliabilities. The Cronbach’s alpha coefficients ranged from 0.772 to 0.940. This high level of internal consistency is shown in the results listed in Table 2, in which all of the values exceed the suggested 0.6 level for scale robustness [33].

Table 2. Construct reliability results

Construct	CR	AVE	Cronbach's α
Intrinsic Motivation	0.926	0.760	0.894
Extrinsic Motivation	0.868	0.686	0.772
Perceived Ease of Use	0.894	0.680	0.844
Perceived Usefulness	0.927	0.719	0.902
Perceived behavioral control	0.871	0.692	0.778
Subjective Norm	0.919	0.654	0.894
Attitude	0.938	0.835	0.901
Behavioral Intention	0.954	0.806	0.940

Composite reliability is a set of latent construct indicators that are consistent in measuring the same construct. Specifically, composite reliability represents the degree of reliability of a set of two or more indicators that are used to measure a construct [33]. The composite reliability coefficients ranged from 0.868 to 0.954 (Table 2). In addition, all of the constructs exhibited a higher composite reliability than the 0.70 benchmark recommended by Fornell and Larcker [31].

We evaluated the convergent and discriminant validity of the model by calculating the AVE for each factor within each model. Convergent validity is established if the shared variance accounts for 0.50 or more of the total variance. Discriminant validity refers to the degree of distinctiveness among the concept measurements. Thus, within the same scale, the correlations among the items should be higher than those of items across various constructs. Discriminant validity is evident if the AVE for each construct is greater than the squared correlation between that construct and any other construct in the model [31]. All the constructs produced AVE values between 0.654 and 0.835 (Table 2), which exceeds the 0.5 benchmark recommended by Fornell and Larcker [31]. Overall, the items demonstrated satisfactory convergent and discriminant validity.

4.2 HYPOTHESIS TESTING

After establishing adequate convergent and discriminant validity, we empirically tested the hypotheses. Table 3 presents the results of the structural model. The PLS analysis results and the standardized coefficients for each hypothesized path in the model and the R-squared for each dependent variable are shown in Fig. 2. All the standardized path coefficients were statistically significant, except the weights of PBC and behavioral intention, excluding H11, which were rejected. Moreover, the R-squared values were used as a goodness-of-fit measure in the PLS analysis [34]. The model explained 70.9% of the variance in nurses' intentions of use e-learning systems, which is indicative of extremely strong explanatory power. Furthermore, perceived ease of use, perceived usefulness, and motivation explain 60.0% of the attitude. Perceived ease of use and motivation explain 52.1% of the perceived usefulness. In addition, motivation explains 29.0% and 29.2% of the perceived ease of use and perceived behavioral control, respectively. The intrinsic motivation and extrinsic motivation explain 100.0% of perceived motivation. The results reveal a high prediction rate in determining user intention. The structural model of this study produced favorable results for motivation, perceived usefulness, attitude and behavioral intention, with 50% explained variance for each construct. However, the perceived ease of use and PBC produced lower but acceptable results, with 29.0% and 29.2%, respectively.

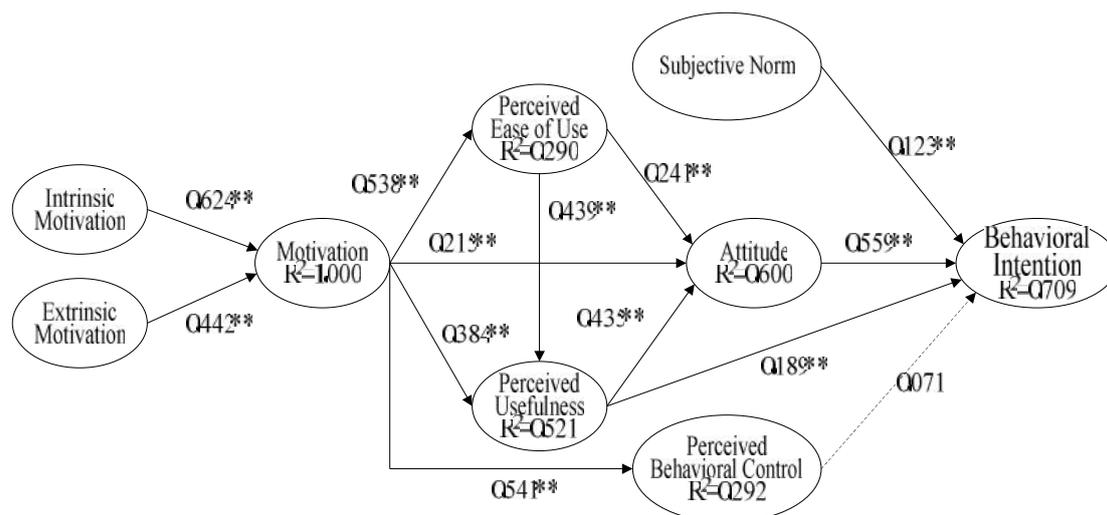


Fig. 2. Structural model results.

Value on path: Standardized coefficients (β), R²: Coefficient of determination and *p < .05, **p < .01.

The path significance of each hypothesized association in the research model by each path was examined, and Table 3 shows the standardized path coefficients and path significance. All 13 hypothesized associations were strongly significant at p < .01 and supported, except for the relationship between PBC and behavioral intention. The path from intrinsic motivation and extrinsic motivation to motivation (H1 and H2), and the path from motivation to perceived ease of use, perceived usefulness, perceived behavioral control, and attitude (H3, H4, H5, and H6, respectively) were determined to be statistically significant at the p < .01 level. The path from perceived ease of use to perceived usefulness and attitude (H7 and H8), and that from perceived usefulness to attitude and behavioral intention (H9 and H10) were determined to be statistically significant at the p < .01 level. In addition, the paths from subjective norms and attitude to behavioral intention (H12 and H13) were supported at the p < .01 level. However, the path from PBC to behavioral intention was not significant in the model. Therefore, H11 was rejected.

Table 3. Estimation results for Hypotheses 1-13

Hypothesis	Path from/to	Standardized path coefficient	t-value	Test results
Hypothesis 1	Intrinsic motivation → Motivation	0.624	76.835**	Accepted
Hypothesis 2	Extrinsic motivation → Motivation	0.442	49.864**	Accepted
Hypothesis 3	Motivation → Perceived ease of use	0.538	15.133**	Accepted
Hypothesis 4	Motivation → Perceived usefulness	0.384	8.225**	Accepted
Hypothesis 5	Motivation → Perceived behavioral control	0.541	13.557**	Accepted
Hypothesis 6	Motivation → Attitude	0.215	4.408**	Accepted
Hypothesis 7	Perceived ease of use → Perceived usefulness	0.439	10.284**	Accepted
Hypothesis 8	Perceived ease of use → Attitude	0.241	5.682**	Accepted
Hypothesis 9	Perceived usefulness → Attitude	0.435	8.815**	Accepted
Hypothesis 10	Perceived usefulness → Behavioral Intention	0.189	3.296**	Accepted
Hypothesis 11	PBC → Behavioral Intention	0.071	1.636	Rejected
Hypothesis 12	Subjective norm → Behavioral Intention	0.123	3.381**	Accepted
Hypothesis 13	Attitude → Behavioral Intention	0.559	9.340**	Accepted

*p < .05, **p < .01

5 DISCUSSION

In recent years, BELS have become the primary alternative educational system and the interface of this system is mainly applied in e-learning. This study integrated motivation, the TPB, and the TAM and proposed a new framework to investigate the behavioral intentions of nurses toward BELS. We conducted a questionnaire survey, data collection, analysis, and arrangement, and applied the statistical techniques of the SEM to obtain an acceptable overall structural model (Fig. 2). The results indicated that reliability, validity, path coefficients, and explained variance (R^2) all produced favorable effects and increased the confidence of the results. We believe that the testing results can be provided to BELS suppliers as references for adjusting the system and increasing learners' behavioral intentions. The empirical results indicated that in the research model proposed in this study, the overall model explained variances in the following potential dependent variables: behavioral intention (0.709; $R^2 = 70.9\%$), attitude (0.60; $R^2 = 60\%$), PBC (0.292; $R^2 = 29.2\%$), perceived usefulness (0.521; $R^2 = 5.21\%$), and perceived ease of use (0.290; $R^2 = 2.90\%$). These data revealed that the theoretical framework proposed in this study can explain the behavioral intentions of nurses toward BELS.

Previous researchers [19] have stated that learners generate extrinsic motivation when they receive tangible rewards. This motivation typically causes people to set higher goals and increases the ability to continually perform related learning behavior. This ability is a crucial motivational element for people. Regarding the forming of motivational perspective, H1 and H2 were supported, which was consistent with previous related studies, such as Goudas et al. [35] and Pierce et al. [16]. They claimed that after people receive external rewards, positive motivational effects are generated by psychological mechanisms to increase their intention to engage in that behavior. Based on the mechanism design of extrinsic motivation, after hospitals introduced information systems, they provided tangible motivation such as external rewards and incentives to encourage employees; thus, users' continual behavioral intentions were further generated. In addition, Goudas et al. [35] stated that motivation is the basis of learning behaviors and greatly influences learners' subsequent continual learning behaviors. In other words, users' motivation to use the system positively influences people's behavioral intentions toward the system. At the early stage when hospitals introduced the training system, nurses' motivations were easily affected by extrinsic motivations (i.e., the incentive of immediate rewards) and intrinsic motivations. Motivation is a formative indicator of second-order factors and did not involve specific evaluation items. Based on the arguments of Deci, et al. [13], the motivation perspective includes extrinsic and intrinsic motivation, and intrinsic motivation is more essential than extrinsic motivation, possibly because the effects of individual intrinsic motivations were generated by hospital operations that were based on teams and workgroups. In addition, the questionnaire items primarily focused on intrinsic factors, including the emotional factor of employees actively using the system, the convenience of acquiring knowledge, and whether the employees found using the system interesting; thus, intrinsic motivation exhibited a higher level of importance than extrinsic motivation did.

The empirical results indicated that perceived ease of use and perceived usefulness positively influenced attitude. The results were consistent with those of Taylor and Todd [11], who proposed that the two attitude beliefs of perceived ease of use and perceived usefulness are crucial antecedent variables that affect attitude in the TAM. In addition, we defined perceived usefulness as a secondary variable of behavioral intention. Several interesting phenomena were observed when comparing previous studies that have investigated the TAM; for example, perceived usefulness influenced behavioral intention more than attitude did [11], [12], [21]. In this study, attitude influenced behavioral intention more than perceived ease of use did and perceived usefulness did not affect user intention significantly. This result was different from that of previous studies [1], [21]. The reasons for this might be that although the nurses all knew that the BELS can assist them at work and increase their learning efficiency, they could not obtain sufficient rest if they used their own time for educational training after work; therefore, perceived usefulness did not influence behavioral intention significantly. If the nurses considered the BELS as an excellent tool and exhibited superior learning attitudes and intentions, the behavioral intentions toward the BELS were increased. Consequently, nurses' attitudes toward the BELS were a crucial mediating variable that affected the influence of perceived usefulness on behavioral intention.

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