

# **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

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**Raheem Abdul Sahib Ogla**

*Computer Sceince Department*

*University of Technology*

Baghdad, Iraq.

**Abdul Monem S. Rahma**

*Computer Sceince Department*

*University of Technology*

Baghdad, Iraq.

110137@Uotechnology.edu.iq

110003@Uotechnology.edu.iq

### ***Abstract-***

The aim of this research is to investigate the problems faced by students in adopting and accepting the use of e-learning in higher education institutions at the University of Technology (UOT). Many researchers have used the factors influencing the acceptance of technology for the perceived usefulness and the perceived ease of use of students' intention to use technology. These factors are used to determine their impact on the acceptance and use of e-learning model provided by the University of Technology. This study seeks to expand the model by suggesting a set of examining variables that can affect both perceived utility and perceived ease of use. In addition to testing the developed model on the use of adopting e-learning in higher education based on a sample of behavior intention of students in UOT. A questionnaire conducted to the students of two collages: computer science and software engineering departments with 258-returned recording 52.2% return rate. The collected data analyzed using SPSS 24 and Excel 2017. To evaluate the measurement and structure the model, the Structural Equation Modeling (SEM) used.

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

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The finding showed that the value of the social norm ( $\alpha=0.83$ ,  $p<0.05$ ) highly predicted perceived usefulness ( $\alpha=0.73$ ,  $p<0.05$ ) also highly predicts perceived ease of use, but, behavior intention (BI) was highly effective by the value of the social norm (SN), perceived usefulness, perceived of easy to use. The behavior intention highly predicts by BI ( $\alpha=0.17$ ,  $p<0.05$ ). It was found that the percentage of variance for students in the intention to use e-learning was 38%.

**Keywords-** Behavioral Intention, e-learning, Innovation Diffusion Theory, Motivational Model (MM), Perceived Usefulness, Perceived Ease of Use, Structural Equation Modeling, Technology Acceptance Model, Theory of Reasoned Action, Theory of Planned Behavior.

## 1. Introduction

Most specialized in educational institutions tend to prefer e-learning to acquire the skill of teaching and education in order to perform their goals of the educational process they imposed by [1]. In the view of [2], the use of e-learning systems may contribute to facilitating and encouraging innovations and increase skills of teaching, learning, and practices in the education environment. aside from, From the point of Laudon's opinion [1], it is not necessary to obtain higher returns unless some of the required free assets are supported, and this does not guarantee the significant investment in e-learning. It is, therefore, necessary to study the factors that affect the acceptance of e-learning applications by students of higher education Institutions. The study and examines students' behavior toward e-learning adoptions by analyzing behavioral intentions and use of behavior. Researchers sought to study and apply a large number of theoretical models of search to manage

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Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

---

---

user behavior. So, there are factors that influence the behavioral intentions in using the acceptance of technology in a correct manner. For example, the models applied have included the Theory of Reasoned Action (TRA) [3], Theory of Planned Behavior (TPB) [4], Motivational Model (MM), Innovation Diffusion Theory (IDT), Acceptance Model of Technology TAM[5], and others. a mixing of TAM-TPB of the models cited as a theoretical model in many cases. While other factors have been used in other models have been expanded. The main thrust of this investigation is that e-learning systems are not significantly used by computer science and software engineering students to teach, learn and research by students and lecturers to develop the learning process, citing [4], assertion that despite the tremendous education in progress technology in e-learning. In addition, the possibility of investing in the new technologies available in teaching and learning, there are few initiatives in adopting these technologies. Many researchers have undertaken such a study to assess why students and lecturers do not use advanced technology in e-learning[5].

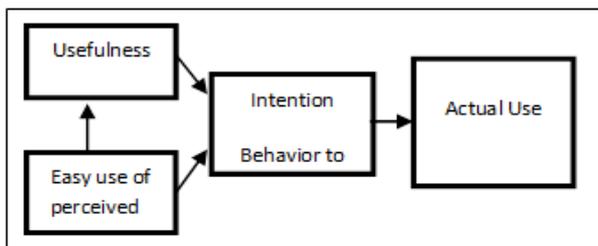
The TAM "Technology Acceptance Model", invented in 1986, is the most widely used theoretical and applied theoretical model in information systems. It was invented by [3], who assumed that the acceptance of information systems by individuals is determined by two variables presidents: usefulness perceived and ease of use perceived, those two variables are influenced by several other factors external factors[6]. The TAM was one of the most important models of acceptance of advanced technology [7], it is typically applied for examining the attitudes of users and behavioral intentions towards accepting the technology. TAM is responsible for

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Oglu

Abdul Monem S. Rahma

collecting the opinions of participants and providing information on the use of internet-based teaching platforms [3]. According to [8], perceived of usefulness (PU) and perceived ease of use (PEOU) affects the intention of students to utilize. So, TAM can be used to decide whether or not to use a particular system. The relationships between TAM structures explains in Figure 1 while, table 1 illustrates the structures of this model and the use of additional construction in the study.[7] Noted that usefulness is more affected in terms of use than ease of use.



## 2. Figure 1: Original TAM Structure[1]

The usefulness perceived was more strongly correlated to the acceptance of using the technology. The important strengths of TAM are that they provide factors to accept the systems information and provide space for expansions and perceptions better than other the corresponding models. Some of the notable shortcomings of users of this model include the failure of this model to find barriers to the utilize of technology[4] and perhaps its simplicity, The reliability of TAM has led to its widespread use and reliability in evaluating and accepting information systems at the expense of other systems. TAM acceptance in IS research was confirmed and based in [9] and as the best choice of models when considering stinginess, lack of costs research and results, for instance, TAM interprets

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

further variation in attitude towards technology acceptance, and a similar proportion of variation in use, compared with the theory of planned behavior [4].

Table 1: Description of TAM Variables

Construct Factors	Descriptions
Usefulness (PU)	“The degree to which a person believes that using a particular system would enhance his or her job performance” [8]
Perceived Ease of Use (PEOU)	“the degree to which a person believes that using a particular system would be free of effort.” [8]
Social Norm (SN)	“refers to a person's perception that most people who are important to him think he should or should not perform the behavior in question.”[3]
Behavioral Intention (BI)	“ Refer to consumers' perceptions of the resources and support” available to perform a behavior”[5]

TAM It is considered one of the unified theories [5]. This model has been developed to be an information systems assessment context and has been designed to predict the acceptance and use of IT. TAM excepts the attitude construct to clarify the best intention very stingy. By TAM extension, TAM2 has been set with a personal standard as a further predictor of intent in state of compulsory configuration

# **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

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(settings). TAM has been frequently used for a variety of applications, systems, technologies, and users[10].

### **3. Literature Survey**

Ashtari, Eydgahi, and Arpaci have suggested the impact of concrete students' suppose relatively to the applications of e-learning in cloud computing. they suggested a model concentrate on the relationship amidst a set of variables perceived e-learning ease of use and students' perception of usefulness existence impact visualization of e-learning technology for students at Southeast Michigan University. In addition, the Technology Acceptance Model (TAM) was applied for the dissection of adopting e-learning by students. In spite of using TAM is become important in estimated technology when adopting e-learning, [11]. And used TAM well to study the reasons and findings e-learning adopting in high education institutions to satisfying knowledge management. The questionnaire was conducted divide among university students in one of the Turkish universities and construed using structural equation modeling. The findings show that educational institutions promote e-learning relying upon through increasing awareness about knowledge management[11].

Militaru (2016) is learning the resulting factors in credence cloud computing in the field of high education with reference to the TAM model by performing a survey of 95 students at a Romanian university. Results showed that effective factors are necessary to enhance cloud CC, to understanding the intention of lecturers and students. this means there is a lack of practical values and limited explanatory [12].

# **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

Raheem Abdul Sahib Oglu

Abdul Monem S. Rahma

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---

## **4. Research Questions**

In spite of TAM, technologies have been utilized to evaluate e-learning application, there are three research questions which need additional investigation for high education in UOT prior it can be added to the e-learning framework.

Q1: Is the intensity of using e-learning effects on the perceived ease of use and the perceived usefulness of students' using e-learning in UOT higher education?

Q2: Is the intensity of using e-learning effect the perceived ease of use and the perceived usefulness of teachers' using e-learning for learning and teaching in UOT higher education?

Q3: How usage the TAM factors predict students' acceptance of perceived usefulness and ease to use.

## **5. Research Methodology**

A questionnaire was conducted to students and teachers of two colleges (Computer Sci. and Software engineering. Only 258 of the students who used the e-learning system scored their responses and the response rate was 51.7% for the adoption of the e-learning system according to TAM acceptance factors.

The methodology adopted the method of targeted sampling and enable the researcher to deepen the behavior of students and teachers towards e-learning and learning [13].

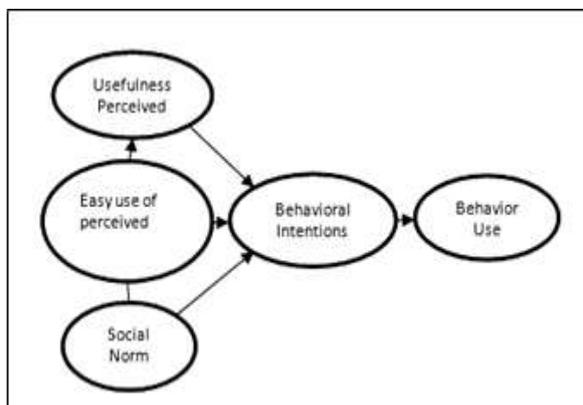
# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Oglu

Abdul Monem S. Rahma

## 6. Research Model

There are problems with student approval (acceptance) of the e-learning system in higher education institutions. The aim of the study is to investigate these problems and identify factors that may affect the usage and acceptance of the e-learning application by students at the University of Technology. Figure 2 describes a five-component study model Davis 1989 [8].



**Figure 2: Framework of components model.**

The structure of the model shows the variables that affect (independent variables, non-independent variables) to obtain the intention of behavior and then use of the intention of the behavior to predict the perceived usefulness and ease of use of a particular system.

## 7. Research Hypothesis

In order to achieve the objective of this study and based on the literature that has been referred to. This study was tested according to the hypotheses shown in Table 2 where Five hypotheses were proposed to test and achieve the objective of this study.

# **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

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## **8. Data Collection and Analysis**

Data was gathered through the website of the University of Technology(UOT) using questionnaire form. The questionnaire, which was designed for this study consists of two parts. Part 1 relied on measuring the Likert seven-gradations as shown in Table 3 and part 2 was used to collect demographic information retrieved from the students who responded as shown in figure 3. The Likert scale consisting of seven gradients (1-7) where strongly agree and strongly disagree ranging from(2-6) respectively, moderately agree and disagree ranging(3-5) respectively, (4) refers to agree, and (1) represent neutral.

The questionnaire was published on the university's website. 520 students participated in the questionnaire. Those who recorded their opinions realistically and serious were 269., registering 51.7%. The generalizations of the questionnaire were conducted by the researcher and the class representatives of the selected categories. This practice was performed directly during the in the website at a different period.

Figure 3 explains the responses of the selected demographics. It is noticed that the rate 51.7% of the responses students uses e-learning application that was provided by the university twice or more per day and the rate 30.1% of the responses students uses the e-learning once or twice in a week. The results of the questionnaire showed that students who used e-learning once and twice a month had a response rate of 1.6 and 4.9, respectively. Students who did not use e-learning provided by the university had 28% response rates.

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

The results of the questionnaire showed that the use of e-learning provided by the UOT to impose its use by students and their teachers is useless and undesirable.

the distribution of the use of e-learning according to the age of the students was listed according to Table 5. The number of students aged 20-30 who did not wish to use e-learning offered by the UOT was 13.4 and 12.2.

The students were aged between 31-44 and older who were not to have the desire to use e-learning was 7.9 and 6.7 respectively.

**Table 2: Research Hypothesis**

<b>Hypothesis</b>	<b>Description</b>
Hyp1	Usefulness of perceived positively affects behavioral intentions to use e-learning Application for learning and teaching by students in the two colleges.
Hyp2	PEOU positively affects on behavioral of students intention to use e-learning

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

Hypothesis	Description
	application.
Hyp3	SN situation positively affect behavioral intentions of students to use e-learning application for learning, teaching, and research.
Hyp4	SN immediately affect PEOU, which affect in turn positively affect PU.
Hyp5	Behavioral intentions directly affect students' usage behavior of e-learning application corroborative for learning.

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

**Table 3: Likert Gradations**

<b>Responses</b>	<b>Ranges</b>
Neumodelt ral	1
Strongly Disagree	2
Disagree	3
Disagree somewhat	4
Moderately	5
Agree	6
Strongly agree	7

The descriptive statistics for "information technology acceptance" (TAM) establishment indicators are shown in figure 5. The values of the computational means and standard deviation for (SN, PEOU, PU,) are shown within range (5-6). Figure 5 shows that most of the student responses are consistent with the statements in the Questionnaire. Where students' responses were limited between (somewhat agreeable and moderately agreeable). The results show that most of the descriptive statistics of the students whose responses were obtained are consistent with the questionnaire statements

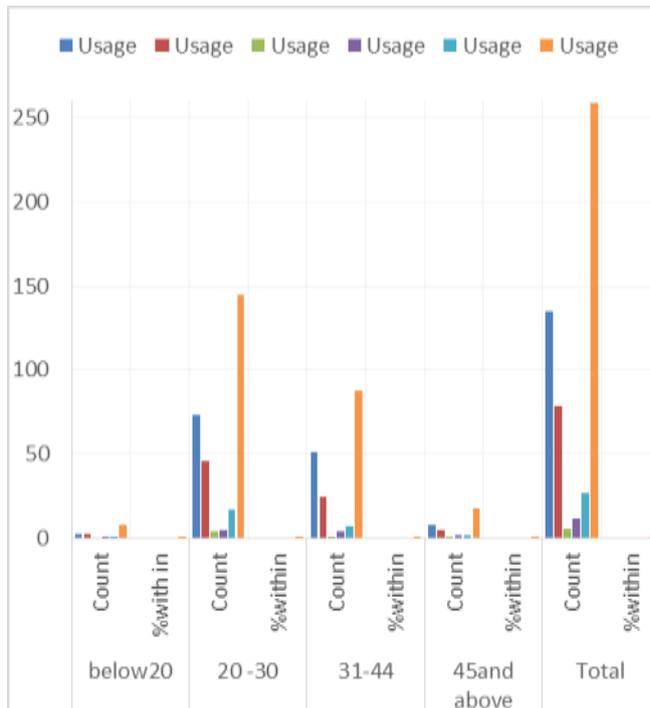
# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogl

Abdul Monem S. Rahma



Figure 3: Demographics of the Responses [N=250]



# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogl

Abdul Monem S. Rahma

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## Figure 4 : Age Usage Cross demonstration

### 9. Measurement Model Analysis

Data analysis performed using "structural equation modeling". The analysis of data implies two necessary steps. this contains the structural and measurement models estimate [9]. The 1st step includes the restriction of approximate or convergent best validity, the 2nd step evaluates the model structural to determine the strangeness and direction of relations between the structures. On a perfect indicator of measurement, loading factors should be at least 0.5. However, 0.8 is the best. In addition to the threshold should be constructed average variance , reliability and the extracted should be 0.5 and 0.8 respectively [14].

### 10. Measurement of Reliability an Validity

SPSS v.14 Microsoft statistical S/W and Excel 2017 were utilized to estimate and evaluate the investigation reliability and validity as a measuring tool. Ave and Cr in Table 5, are computed according to the equations:

Where

Ave: Average variance extracted

Cr: Composite reliabilities

FL : Loading factor

ME: Measurement error

$$\alpha + \beta = \gamma \quad (1)$$

## Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

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$$Cr = (\sum FL / ((\sum FL)^2 + \sum ME)) \quad (2)$$

$$Ave = \sum(FL)^2 / n \quad (3)$$

The above equations (1,2,3) utilized to gauge the average variance and reliability extracted sequentially. Ave was measured to test the convergence of validation. Table 5 shows the portray adequate evidence of validity and reliability because the loading factor exceeds 0.5, Cr and Ave values exceed the bespoke threshold value (0.7 and 0.5) sequentially.

In the view of [9], to estimate the fitness of the system to be evaluated, It is appropriate to utilize one incremental fit measures and at least one absolute. in addition to the Chi-square  $X^2$  and the related degrees freedom. Table 4 shows fit indices, bespoke cut-off values, and critical values . These values are recommended

by many researchers. The following are the results that reveal the measurement of the model with the data collected.[15]

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogl

Abdul Monem S. Rahma

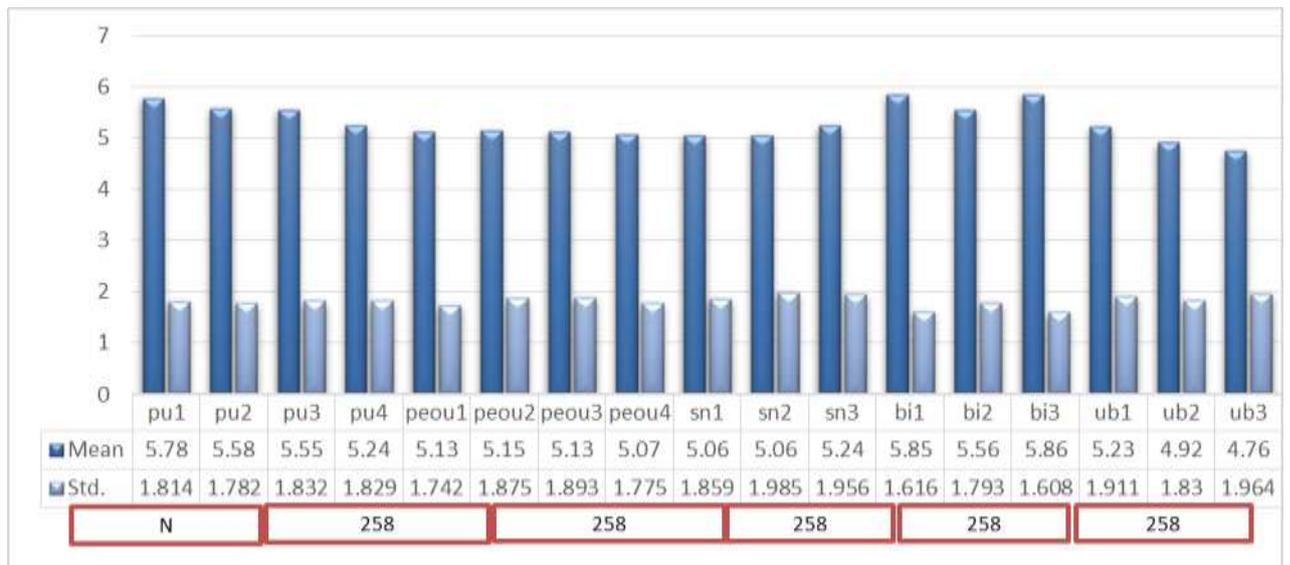
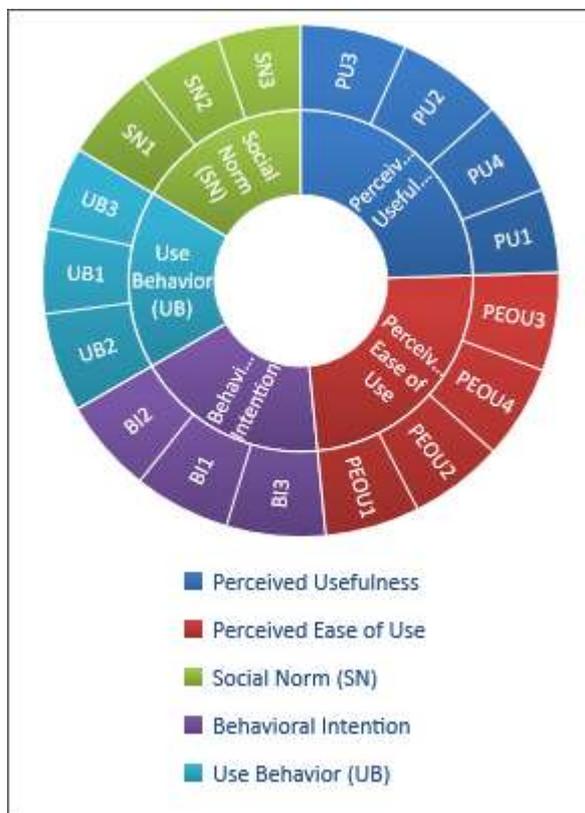


Figure 5: Data for e-Learning Adopting Based TAM Factors



# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Oglu

Abdul Monem S. Rahma

## Figure 6: Standards loading terms, Average Composite, variance and reliability extended

The results of research conducted in the field of acceptance of technology have varied and different results with different models or theories of acceptance technique. The results of some researches are in line with the findings of the original researchers, and some of the results of the research were inversion to the initial research findings.

Table 4: Findings cut off and actual values

Fit-Indices	Cut-off	Actual Values	Authors
X2/df	<3	1.55	[15]
AGFI	>0.7	0.90	[16]
RMSEA	<.0.08	0.46	[17]
CFI	>0.90	0.98	[15]
NFI	>0.90	0.94	[18]

# **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

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Abdul Monem S. Rahma

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## **11. Discussion**

In this study, the researchers seek to provide a better understanding of the issues related to the acceptance of e-learning technology by students in higher education institutions using TAM with self-defined standards. The impact of SN, PEOU, and PU on the behavioral intentions of using e-learning technology in higher education was not statistically significant and contrasted with [15] in the technology acceptance test model to assess the intention of health care professionals to use a malicious reporting system. The results then suggest SN foresee PEOU significantly. PEOU also has a significant and positive effect of PU. This is in line with the expectations of [16]. Figure 6 shows the relations between the variables PU, PEOU, SN, BI, and UB. [17]

## **12. Conclusions**

The study shows visions and private behavior for students of the University of Technology towards the use of e-learning model when applying the expanded technology acceptance model (TAM) when the Social Norm (SN) was added and implemented. Among the five hypotheses that were stated, three of them was supported by the model. It is noted that SN has been highly foresees by PEOU which subsequently highly foresees by PU and BI also highly foreseeing the UB. The finding shows students impacts are essential contributors to students' ease of use perceived for the e-learning supported by the University of technology for learning, teaching, and research. It is there for necessary for stockholders (students, lecturers, and educational management) related to these educational establishments to used lecturers and categories to

# Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students

Raheem Abdul Sahib Ogla

Abdul Monem S. Rahma

nature of the establishment of the ease of using e-learning applications Ad Hoc for teaching, learning. Besides, From the researcher's point of view, the students will discover the ease of using the e-learning model through practice and will recognize the usefulness of the tools that will motivate students to formulate intentions to use e-learning provided by the university and are encouraged to use it to improve learning, research and information search.

**Table 5: Variables Relationship**

Paths			Rc	Se	Cr	SL
<i>PEOU</i>	<i>relation</i>	<i>SN</i>	.843	.072	11.8323	+++
<i>PU</i>	<i>relation</i>	<i>PEOU</i>	.747	.061	11.663	+++
<i>BI</i>	<i>relation</i>	<i>PEOU</i>	.362	.187	1.889	.057
<i>BI</i>	<i>relation</i>	<i>PU</i>	.175	.134	1.271	.212
<i>BI</i>	<i>relation</i>	<i>SN</i>	.037	.142	0.268	.78
<i>UB</i>	<i>relation</i>	<i>BI</i>	.168	.077	2.179	.03

## References

- [1] K. C. Laudon and J. P. Laudon, "Management Information Systems Managing The Digital Firm", Twelfth Edition, Pearson Prentice Hall 2012. ISBN-10: 0-13-214285-6
- [2] K.Loogma, J. Kruusvall And M. Umarik, "E-Learning As Innovation: Exploring Innovativeness Of The Vet Teachers' Community In Estonia", Elsevier ,Vol 58, No2, , Pp. 808-817, Feb 2012. <https://doi.org/10.1016/j.compedu.2011.10.005>
- [3] Y. Gallaher, "Technology Planning: A Roadmap to Successful Technology Integration in Schools", ELSEVIER, vol.49, no.4, pp. 943-956, 2007.

## **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

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- [4] V.Venkatesh, M. G. Morris, G. B. Davis and F. D. Davis, "User Acceptance of Information Technology: Toward a Unified View", MIS QUARTERLY, vol. 27, no. 3, pp. 425-478, 2003. <https://DOI:10.2307/30036540>
- [5] A. Rilwan and S. M. Abdulrahman, "Cloud Computing Based e-Learning: Opportunities and Challenges for Tertiary Institutions in Nigeria," International Journal of Engineering, Business and Enterprise Applications, vol. 5, pp. 144-152, 2015. <https://DOI:10.17706/ijeeeee.2015.5.3.144-152>
- [6] W. Awad ,F. Omara and D. Elmatary, "SLA for E Learning System Based on Cloud Computing," International Journal of Advanced Computer Science and Applications,, vol. 6, no. 10, 2015. <https://DOI:10.14569/IJACSA.2015.061027>
- [7] F. D. Davis, "Perceived Usefulness, Perceived Ease of Use, And User Acceptance of Information Technology", vol. 13, no. 3, pp. 319-340, 1989. <https://doi:10.2307/249008>
- [8] S. Ashhtari and A. Eydghahi, "Student Perceptions of Cloud Applications Effectiveness in Higher Education", ELSEVIER, Vol 23, pp.173-180 Nov 2017. <https://doi.org/10.1016/j.jocs.2016.12.007>
- [9] J. Lee, F.A. Cerreto and J. Lee "Theory of Planned Behavior and Teachers' Decisions Regarding Use of Educational Technology", journal of educational technology & society, vol. 13, no. 1, pp. 152–164, 2010. <https://www.jstor.org/stable/jeductechsoci.13.1.152>
- [10] W. Alghabban and A. Elgelany, "Cloud Computing: Empirical Studies in Higher Education A Literature Review", Vol.8, No. 10, 2017. <https://DOI:10.14569/IJACSA.2017.081017>
- [11] I. Arpaci, "Antecedents And Consequences Of Cloud Computing Adoption In Education To Achieve Knowledge

## **Adopting E-learning Model Based On The TAM Expansion Through Subjective Norm to Discover Intentions of Students**

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Management", ELSEVIER, Vol 70, Pages 382-390, May 2017.  
<https://doi.org/10.1016/j.chb.2017.01.024>

[12] G. militaru and A. A. purcarea, "Examining Cloud Computing Adoption Intention in Higher Education: Exploratory Study", International Conference on Exploring Services Science, 2016.

[https://DOI:10.1007/978-3-319-32689-4\\_56](https://DOI:10.1007/978-3-319-32689-4_56)

[13] A. Alharthi, M. O. Alassafi and R. J. Walters ,” An exploratory study for investigating the critical success factors for cloud migration in the Saudi Arabian higher education context ”, Vol 34, No.2, Pages 664-678, 2017.

<https://doi.org/10.1016/j.tele.2016.10.008>

[14] J. F. Hair, Jr. William, C. Black Barry ,J. Babin Rolph and E. Anderson,” Multivariate Data Analysis”, Pearson Education Limited,2010.

[www.pearsoned.co.uk](http://www.pearsoned.co.uk)

[15] Jen-Her Wu,Wen-Shen Shen,Li-Min Lin and R. A. Greenes, "Testing The Technology Acceptance Model For Evaluating Healthcare Professionals' Intention To Use An Adverse Event Reporting System," Vol 20,No 2, Pages 123–129, Apr2008.

<https://doi.org/10.1093/intqhc/mzm074>

[16] S. J. SHIM and V. Viswanathan" User Assessment Of Personal Digital Assistants Used In Pharmaceutical Detailing: System Features, Usefulness And Ease Of Use," THE JOURNAL OF COMPUTER INFORMATION SYSTEMS, vol. 48, no. 1, pp. 14-21, 2007.<https://www.tandfonline.com/doi/abs/10.1080/0887447>

[17] A. Alharthi, M. O. Alassafi and R. J. Walters, "An Exploratory Study For Investigating The Critical Success Factors For Cloud Migration In The Saudi Arabian Higher Education Context", Vol.34, No. 2, PP. 664-678,2016.<https://doi.org/10.1016/j.tele.2016.10.008>.