Shih, J. L. et al. (Eds.) (2019). Proceedings of the 27th International Conference on Computers in Education. Taiwan: Asia-Pacific Society for Computers in Education

Introduction of Educational Technology Engagement Model

Ibrahim Hakki BULUT[a*] & Omer DELIALIOGLU[b]
[a] *PhD Student, Istanbul Medeniyet University, Turkey*
[b] *Prof. Dr., Middle East Technical University, Turkey*
*ibrahim.bulut@medeniyet.edu.tr

Abstract: This paper proposes an educational technology adoption model considering the limitations of traditional technology adoption models. Based on the model, the authors develop a questionnaire, in which the items are derived from previous technology adoption studies, to identify and indicate the constructs in the proposed model. The paper presents the statistical validity and reliability of the questionnaire. The results based on Exploratory Factor Analysis (EFA) indicate that the items on the questionnaire that are meant to measure the constructs in the model are statistically valid and reliable.

Keywords: Educational technology, technology adoption model, TAM, technology engagement

1. Introduction

With the change of Web 2.0 technologies in the late 90s, Internet dynamics changed dramatically. Users have become more active participants and content creators thanks to Web 2.0 tools made it easier and more accessible. Web 2.0 not only allows individuals to benefit from technologies, systems, and tools on an instrumental level, but also allows them to engage in social and cognitive involvement, and hedonic immersion through various tools.

The development in technology does not only affect the dynamics of everyday life, but also affects the dynamics of education. A recent study indicates that smartphones are used by 87% of US students, 74% of them have at least a computer, and 41% have access to a tablet in which every device has access to Internet, and at least one social media platform is followed regularly by 97.5% of US youth (Villanti et al., 2017). High adoption of Web 2.0 technologies has guided teachers to benefit from them for instructional purposes. Integration of new technologies into schools and classrooms is no longer limited with entrepreneur instructors. E-mail use to communicate between students and instructors, material delivery through system tools, usage of Office programs to create and demonstrate content, and searching Internet to access specific knowledge are regarded as common technology-mediated teaching practices in the last two decades (Chen et al., 2010; Laird & Kuh, 2005). In addition, there are many popular educational applications and systems highly adopted by both academicians and teachers to engage students in learning activities (Elmas & Geban, 2012).

Information and Communication Technologies (ICT) in education necessitate specific focus in terms of acceptance and engagement since they become an integrated component of instruction. The aim of educational technologies, a special form of ICT, is to improve learning, strengthen educational processes and increase students' success. Achieving these objectives requires the systematic implementation of theory to educational practices from the relevant studies especially from motivation and engagement studies. Therefore, the current study finds it valuable to define motivators that anticipate the adoption of technology, and identify and detail the likely relationships among these motivational constructs. Taking into account all of these, the current study's purpose is to offer a new model called Educational Technology Engagement Model (ETEM) by considering the changing dynamics and paradigms over technology, current role of technology over society and anticipated influences on education. Another aim of the study is to test a questionnaire composed of several scales derived from previous studies in the technology adoption and acceptance literature and to decide if the questionnaire is statistically powerful to be able to be utilized in prospective studies on which ETEM is to be based.

2. Literature Review

It has been a challenge for technology acceptance model practitioners for 3 decades to illuminate the underlying motivators to understand why some of the technologies are excessively embraced by the Internet community (Davis, 1985; Bagozzi, 2007). Technology acceptance models can be defined as contextual scaffolds extracted from motivational theories to portray user adoption of technologies. They try to illuminate user participation based on the demographics, characteristics and perceptions of the intended population. Technology adoption models provide a comprehensive framework by identifying what needs to be satisfied as a prerequisite to adopt technology, and how motivators and technology use behaviors are interrelated.

Technology Acceptance Model (TAM) (Davis, 1985) is the most popular adoption model among several others since it is the most referenced, applied, modified, extended, and criticized one in the technology acceptance literature. TAM suggests that users are exposed to 2 motivational beliefs - Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) - when interacting with a new technology. These beliefs determine their adoption decisions. PU refers to perceived advantages emanating from utilizing of a specific technology. PEOU refers to individual assessment of to what extent the utilized technology is easy to use (Cole, 2009).

The model predicts that external factors as independent factors affect PU and PEOU as motivational beliefs. Both PU and PEOU are the estimators of the intention to use to predict the adoption of technology. The parsimonious structure has risen it to a leading model to predict user motivation to accept technology use. It has been repeatedly replicated, implemented and tested for different systems, tools and technologies (Chutter, 2009). However, the basic structure of the model has been criticized several times, leading to efforts to expand by researchers to make it more descriptive.

Although the accuracy and strength of TAM have been tested and verified in many studies, it has been severely criticized several times in terms of several aspects including parsimonious structure and lack of intrinsic motivators (Bagozzi, 2007; Silva, 2007; Smith et al., 2007; Lee, Kozar, & Larsen, 2003). TAM has long been functioning as a theoretical framework that aims providing a single solution for various technologies to explain user motivation of their adoption. However, the parsimonious structure of TAM by regressing to only 2 factors as PU and PEOU to explain adoption causes to dismiss the genuine latent variables that are presumably to refer to technology acceptance problems (Lee et al., 2003). Moreover, ignoring intrinsic factors, which are likely to explain intrinsic motivation via addressing cognitive, social and hedonic needs of humans, is another criticized aspect of TAM resulting in lack of useful information to understand technology adoption of 21st users (Bagozzi, 2007). Lastly, TAM and its derivatives disregard the ever-changing direction and progress in the relationship between technology and society. Although technology is seen as an apparatus accepted for its benefits in the late 80s and early 90s, human interplay with technology have increased to a more advanced level of involvement and commitment at the social and cognitive level after 2000s. Considering the increasing use of internet and social media and the availability of smart devices, society is far beyond the initial acceptance of technology. Although they are sufficient to explain what motivators can predict to make technology a part of people lives, they are weak in explaining how individuals are involved in technology and are part of it. In addition, the behaviorist characters of TAM focusing mostly on systematical components and ignoring the systemic and social components of technology (Smith et al., 2007) presents a partial explanation of the acceptance of technology. As a result, traditional technology acceptance models might benefit from being replaced and updated with new motivational constructs and determinants to overcome aforementioned limitations.

3. Methodology

Existing technologies and systems offer distinct characteristics with systemic, social and technical elements making them unique. Considering the complexity of technology and a broad array of technologies fulfilling several needs, attempts to identify user acceptance grounded on a theoretical framework is oversimplification. Therefore, Smith and his colleagues (2007) recommend proposing contextual models through process-based analysis. Based on the recommendation, analyzing the underlying motivational process toward adopting and using a specific technology through the lens of

one or more theory of motivation is more appropriate rather than directly suggesting a more extended and excessive model without a theoretical justification.

As the first step, the appropriate motivational theory was determined by considering specific technology's idiosyncratic structure and the circumstances in which it is being implemented. Both intrinsic and extrinsic motivation play an essential role on the adoption of educational technologies therefore Self-determination Theory (SDT) was decided to be grounded because SDT considers both intrinsic and extrinsic motivators over the engagement of students (Ryan & Deci, 2000). Basically, SDT defines two types of motivation as extrinsic and intrinsic. Extrinsic motivation refers to the motivation of individuals who are arisen and fed from sources outside the scope of the task and independent from the activity. Intrinsic motivation can be defined as self-acceptance and inherent tendency to engage in a specific behavior to achieve the intended results. (Ryan & Deci, 2000). Considering the relevant constructs in SDT, a theoretical model – Educational Technology Engagement Model (ETEM) was drawn as can be seen in Figure 1. Technology-related factors derived from previous adoption studies are mounted into the model to identify relevant motivational constructs of STD.

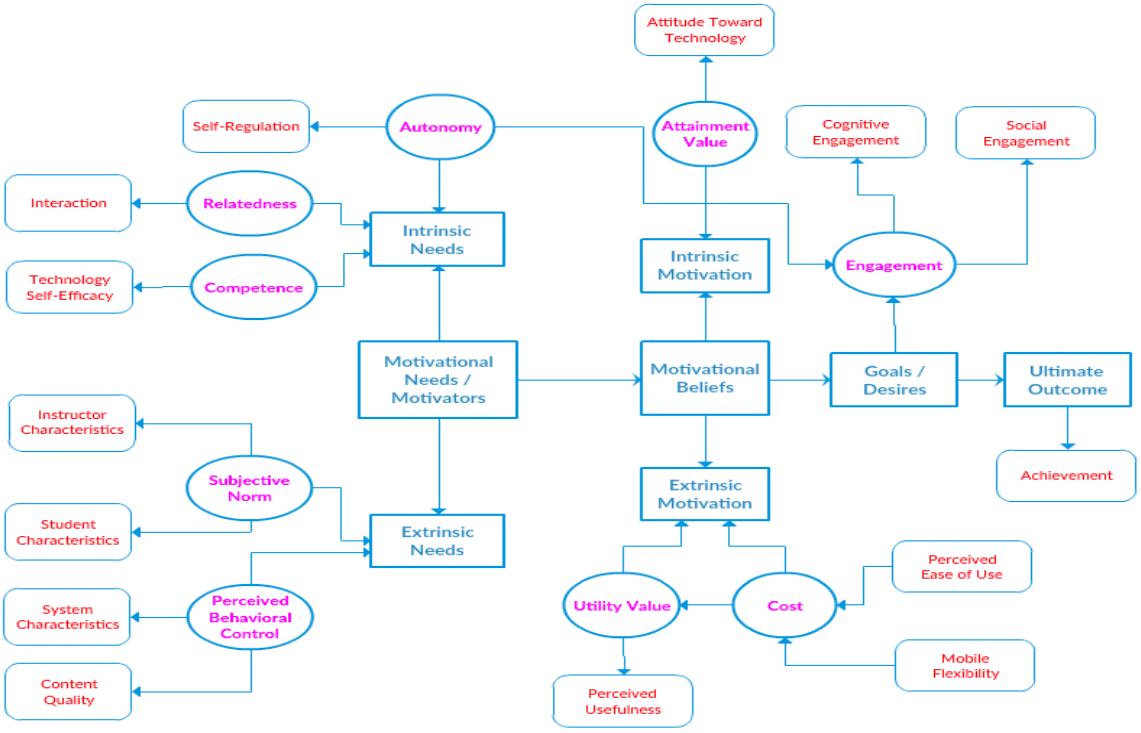

Figure 1. ETEM – A Theoretical Model for Educational Technologies

To test the model being constructed, Edmodo which defines itself as a social learning platform was selected since it is considered an ideal platform as a self-sustained learning environment with its tools and facilities rather than being a complementary technology making instruction and learning easier. Based on the chosen Educational Technology, the population of the study was determined as students at Turkish universities where Edmodo is used actively as the learning environment in Introduction to Information Technologies and Applications (IITA) course taught throughout Turkish universities as a mandatory course. The reason for selecting this course is due to enabling instruction to occur without requiring face-to-face instruction and due to expecting higher engagement and participation of students. Accordingly, 4 instructors who utilize Edmodo intensely for educational purposes by using every tools and utilities of Edmodo to instruct IITA at 4 Turkish universities, namely Amasya, Harran, Ege and Middle East Technical Universities, and their students are selected as samples of the study. Thus, 520 students from 4 universities became conclusive participants of the study.

To be able to base ETEM as a theoretical model in prospective studies, a questionnaire was composed of various scales whose items are extracted from past technology acceptance studies. The scales aim to identify and measure relevant constructs within the motivational concepts in the model,

namely motivational needs, beliefs, goals and ultimate outcome. Some of the sample items, factor names where these items point to, and original sources of the items can be found at Table 1.

Table 1

Sample Items and Sources

Factor	Sample Items	Sources
Content Quality	The contents shared in Edmodo is relevant to the course	Roca et al. (2006)
Technology Attitude	Students learn better in courses where computers are actively used	Arslan (2006)
Social Engagement	Edmodo enabled students to share their feelings and opinions easily	Paechter et al. (2010)
Interaction	My instructor encouraged me to use Edmodo	Soong et al. (2001)
Self-regulation	I am able to learn at my own pace	Lee & Tsai (2011)

The online version of the scales was delivered to the instructors share with participant students at the end of 2016-2017 Fall semester. The instructors shared the survey with students and sent them reminders to complete it. 520 students in total filled out the scales. After data collection, the validity and reliability of scales were checked through Exploratory Factor Analysis and Reliability Analysis.

4. Results

The purpose of the study was to discover latent variables for technology adoption by gathering and analyzing data. Exploratory Factor Analysis (EFA) was used in the analysis of the research data. EFA was conducted to indicate whether expected latent variables are appropriately obtained and the instrument satisfies the required conditions for validity and reliability. 520 students from 4 universities became participant for the study. The survey instrument consists of 84 items. Responses were on a 5-point scale, ranging from “Strongly Disagree” to “Strongly Agree”.

Firstly, outliers and missing data were inspected to proceed for further analysis. Box-plots and z-scores were examined to identify outliers. 42 data points with standardized scores above 3.29 and positioned outside the fences of the boxplots were identified as outliers thus 42 cases were excluded from further analysis. Consequently, assumptions were analyzed based on the data collected from 478 samples. 84 scale items were firstly examined for the factorial structure. Correlation matrix indicated that all of the items are correlated (> .30) with at least one other item therefore a reasonable factorial structure can be proposed (Hair et al., 2010). As can be seen in Table 2, the KMO value was .96, above the recommended value of .60, and Bartlett’s test of sphericity was significant ($p < .05$). Univariate normality assumption was controlled by looking at descriptive statistics and through statistical kurtosis and skewness values of the variables. The results met the required interval (-3/3) indicating univariate normality (Tabachnick et al., 2007).

Table 2

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.96
Bartlett's Test of Sphericity	Approx. Chi-Square	31463.38
	df	3486
	Sig.	.00

The initial eigenvalues showed that 13-factors solution was suitable for adoption because first 13 factors have eigenvalues greater than 1.0 and they explained 67.37% of total variance which is above the recommended value of 60% in social sciences (Hair et al., 2010).

The pattern matrix indicated that all items contributed to one of the 13 factors and there was no significant relationship among factors. In order to determine whether the item is loaded sufficiently on the relevant factor, a minimum criterion value of .30 was adopted for factor loading (Tabachnick & Fidell, 2012). According to the criteria, 5 items with loadings below .30 were removed from the scale.

Reliability Analysis was conducted to determine if every scale in the questionnaire functions accurately and internally consistent. Cronbach alpha score was calculated for every factor and internal consistency of each obtained factor was analyzed using Cronbach's alpha value. The acceptable range for Cronbach alpha test of reliability is .70 or above, and .80 or greater is preferred (Cortina, 1993). Cronbach's Alpha Values for each factor is shown in Table 3. Alpha values are above .80 indicating that internal consistency for every factor are beyond acceptable. It was also investigated that if any of the items were deleted, alpha scores would increase significantly. Since Cronbach's alpha values for the factors did not decrease when 4 items were deleted, these items were found to be incompatible with the related factors. All 4 items were dropped from the scales. As the final result, 9 items were removed from the questionnaire and 75 items remained for further analysis in prospective studies.

Table 3

Cronbach's Alpha Values

Factor	Cronbach's Alpha	Factor	Cronbach's Alpha
Perceived Usefulness	.92	Perceived Achievement	.89
Self-efficacy	.82	Student Characteristics	.92
Cognitive Engagement	.93	Interaction	.92
Content Quality	.88	System Characteristics	.87
Technology Attitude	.90	Mobile Flexibility	.92
Perceived Ease of Use	.93	Self-regulation	.89
Social Engagement	.90		

5. Conclusion

The technology adoption models, especially TAM, have guided researchers over 30 years to explain how motivators have influenced human usage of technology. They grant a broad and inclusive lens for understanding the relationship between the needs and the beliefs of users and the objectives and outcomes of using technology. The appropriateness of TAM is questioned considering the ever-changing direction and progress beneath the motivation to adopt and use 21st century technologies. Taking the limitations into consideration, the study introduces a new approach to develop technology models, requiring a theoretical understanding of the relevant motivational structures and processes involved while adopting a new technology. Based on the approach, Educational Technology Engagement Model (ETEM) is proposed considering that current adoption models are not ideally suited to identify adoption of educational technologies due to their disregard of intrinsic factors. The study also developed a comprehensive questionnaire in which the items are derived from various sources to identify and indicate the constructs in the model. The validity and reliability of the items in the questionnaire are proved through EFA and Reliability Analysis. It is desired that both information systems experts and technologists in general, and especially educational technology practitioners and researchers, take advantage of ETEM and help the authors of current study improve and update the proposed model through their criticism and feedback, and also further statistical analyses including Confirmatory Factor Analysis and Structural Equation Modeling.

References

Arbaugh, J. B. (2000). Virtual classroom characteristics and student satisfaction with internet-based MBA courses. Journal of management education, 24(1), 32-54.

Arslan, A. (2006). Bilgisayar destekli eğitim yapmaya ilişkin tutum ölçeği. Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 3(2), 24-33.

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. Journal of the association for information systems, 8(4), 3.

Chen, P. S. D., Lambert, A. D., & Guidry, K. R. (2010). Engaging online learners: The impact of Web-based learning technology on college student engagement. Computers & Education, 54(4), 1222-1232.

Chuttur, M. Y. (2009). Overview of the technology acceptance model: Origins, developments and future directions. Working Papers on Information Systems, 9(37), 9-37.

Cole, M. (2009). Using Wiki technology to support student engagement: Lessons from the trenches. Computers & education, 52(1), 141-146.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. MIS quarterly, 189-211.

Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. Journal of applied psychology, 78(1), 98.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340.

Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Doctoral dissertation, Massachusetts Institute of Technology).

Elmas, R., & Geban, Ö. (2012). Web 2.0 tools for 21st century teachers. International Online Journal of Educational Sciences, 4(1), 243-254.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. Psychological methods, 4(3), 272.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. (2010). L. (2010). Multivariate data analysis. Pearson.

Laird, T. F. N., & Kuh, G. D. (2005). Student experiences with information technology and their relationship to other aspects of student engagement. Research in Higher Education, 46(2), 211-233.

Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. Communications of the Association for information systems, 12(1), 50.

Lee, S. W. Y., & Tsai, C. C. (2011). Students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning. Computers in human behavior, 27(2), 905-914.

Liaw, S. S., Huang, H. M., & Chen, G. D. (2007). Surveying instructor and learner attitudes toward e-learning. Computers & Education, 49(4), 1066-1080.

Paechter, M., Maier, B., & Macher, D. (2010). Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction. Computers & education, 54(1), 222-229.

Pintrich, P. R. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).

Pituch, K. A., & Lee, Y. K. (2006). The influence of system characteristics on e-learning use. Computers & Education, 47(2), 222-244.

Roca, J. C., Chiu, C. M., & Martínez, F. J. (2006). Understanding e-learning continuance intention: An extension of the Technology Acceptance Model. International Journal of human-computer studies, 64(8), 683-696.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary educational psychology, 25(1), 54-67.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55(1), 68.

Smith, S., Johnston, R. B., Shanks, G., & Rahim, M. M. (2007). Toward a motivational theory of technology implementation processes. In European and Mediterranean Conference on Information Systems. Polytechnic University of Valencia, Spain.

Soong, M. B., Chan, H. C., Chua, B. C., & Loh, K. F. (2001). Critical success factors for on-line course resources. Computers & education, 36(2), 101-120.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). Using multivariate statistics (Vol. 5). Boston, MA: Pearson.

Villanti, A. C., Johnson, A. L., Ilakkuvan, V., Jacobs, M. A., Graham, A. L., & Rath, J. M. (2017). Social media use and access to digital technology in US young adults in 2016. Journal of medical Internet research, 19(6).

Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. Academy of management journal, 40(6), 1282-1309.