PAPER

Using Technology Acceptance Model to Discuss Factors in Distance Learning Behavior

Meng-Dar Shieh, Hsin-Yin Hsieh(✉)

Department of Industrial Design, National Cheng Kung University, Tainan, Taiwan

P38094036@ncku.edu.tw

ABSTRACT

Due to the COVID-19 pandemic, distance learning is required during school closures and group classes for students' continuous education during quarantine. There are various distance learning platforms, each with distinct characteristics, whose functions are unknown. The application of the technology acceptance model (TAM) to discuss distance learning behavior is therefore studied. University students in Taiwan took part in this research. In total, 450 copies were prepared from the questionnaire to implement in the sample. The invalid and incomplete forms were removed, and in total, 364 copies were subjected to the data analysis. The valid forms' ratio was found to be 81%. The research results are summarized below. 1. Students consider the user-friendliness of distance education to be the system design, response time, and display being simple and convenient with a fast response and few mistakes. 2. The impact of information value on perceived user friendliness explains that distance learning with correct, conforming to needs, complete, and real-time information could have students consider the ease of use of distance learning. 3. For students, distance learning is helpful for learning or easy to operate, as they would enjoy using it and further enhance their willingness to continuously use it. According to the results of the proposed discussions, it is expected to help teachers, when using digital technologies for teaching, successfully apply media to enrich traditional teaching environments and integrate various resources to achieve effective learning.

KEYWORDS

technology acceptance model (TAM), distance learning, learning behavior, system quality, information quality

1 INTRODUCTION

Information technology (IT) has been one of the most rapidly developing technologies since the end of the 20th century. Almost everyone's life is closely related to IT. Information shows great influence on human society, and its application to instruction is gradually becoming more prevalent in modern education. Along with the

emergence of technology and media, people are changing their knowledge-receiving methods. The emergence of the Internet extends all over the world. Effectively using technology and media to enhance teaching effectiveness becomes the emphasis in educators' curriculum mapping. The approach of the information age facilitates the advance of science and technology and results in major changes in humans' lifestyles. To cope with the trend of globalization and digitalization, many educators attempt to integrate technologies into instruction. Using information technology as a tool for delivering information and solving learning problems, as well as assisting in teaching and learning, allows learners to be more active and positive to construct meaningful learning environments and actively control the interaction with technologies to satisfy their learning needs through the application of technologies and effectively enhance learning effectiveness. In traditional teaching and learning styles, teachers and students are restricted to the same location at the same time. Nevertheless, time and distance often result in dilemmas or inconveniences between teaching and learning in humans' learning processes. The rapid advancements of information and communication technologies transcend the limitations of time and geography. The emergence of computers and the Internet has hugely changed teaching styles. Distance learning provides learners with learning opportunities without facing teachers and overcomes the barriers to learning caused by time and distance with diverse learning styles through technology and media to precede two-way interaction with teachers.

COVID-19 pandemic broke out in Wuhan, when merely one country in the world announced partial school closures. Along with the spread of the pandemic, an increasing number of students were affected. To prevent students from not being able to go to school, schools started to prepare for distance learning. Now, due to students' needs for education in the pandemic outbreak, educational units and non-governmental digital learning resources provide various websites, software, and platforms for schools and teachers preceding distance learning. It reveals that distance learning has become an essential trend in the world. Due to school closure and the need for distance learning in group classes, distance learning is promoted for students continuing their education during quarantine when schools are closed. The pandemic results in nationwide school closures and the use of distance learning. The system design and equipment construction on various websites and platforms are distinct. During the nationwide school closure, some platforms are simultaneously used by a large number of students, and the servers cannot bear the load, resulting in students not being able to connect or log in. Teachers and students therefore use other platform resources to complete the classes. Various distance learning platforms present these characteristics, but the functions of distance learning are unknown. For this reason, the technology acceptance model (TAM) is applied in this study to discuss distance learning behavior, expecting to help teachers, when teaching with the assistance of digital technologies, successfully apply media to enrich traditional teaching environments and integrate various resources to achieve effective learning.

2   LITERATURE REVIEW

2.1   Information system success model

Hsu et al. [1] stated that DeLone and McLean, in 1992, were the first researchers to develop an information system success model. They reviewed and integrated several researchers' studies, including the communication theory developed by Shannon and Weaver in 1949 and Mason's (1978) information impact theory. Altikulaç et al. [2]

pointed out six dimensions in the information system success model: namely individual impact, information quality, organizational impact, user satisfaction, system quality, and system use.

Zheng et al. [3] referred to the adapted information system success model proposed by DeLone and McLean in 2003, which included the addition of service quality. They argued that evaluating an information system accurately necessitated the inclusion of service quality measurement. The modified information system success model is explained below.

1. System quality: evaluation of the overall information system
2. Information quality: evaluation of the output information system quality
3. Service quality: evaluation of service provided by the information system for users, including tangibility, reliability, responsiveness, assurance, and empathy
4. Usage/use intention: referring to the situation when users using the information system in different situations (e.g., using with personal will), intention would be more suitable
5. User satisfaction: referring to user satisfaction after using the information system, which could be the information system output or the overall perception of the use
6. Net benefit: referring to effects from the use of information systems, which could be positive or negative

The following hypotheses are therefore proposed.

H2: System quality has a positive impact on students' perceived user-friendliness of distance education.
H3: System quality positively affects students' perceived user-friendliness of distance education.
H4: Information quality positively influences students' perceived user-friendliness of distance education.
H5: Information quality positively influences students' perceived usability of distance learning.

2.2 Technology acceptance model

Pee et al. [4] elucidated that Davis conceptualized the TAM drawing upon the Theory of Reasoned Action (TRA) postulated by Fishbein and Ajzen in 1975. Within the TRA framework, it was posited that behavioral intention determines actual behaviors predominantly. This is modulated through attitude towards the behavior and the subjective norm. Contrarily, Bralić and Divjak [5] identified a diminished significance of the subjective norm, which impacts behavioral intention. Consequently, they excluded the subjective norm, integrating perceived ease of use and perceived usefulness into the model. They postulated that these newly incorporated constructs would engender changes in attitude towards usage, sequentially impacting behavioral intentions and leading to alterations in actual behavior.

Extending the original TAM, Lin et al. [6] incorporated elements of social influence and cognitive instrumentation into their model. Chakraborty [7], within the domain of social influence, integrates constructs such as image, voluntariness, and subjective norm. Furthermore, within the cognitive tool paradigm, they encompassed output quality, work relevance, clarity of the result, and perceived user-friendliness.

These augmented processes were hypothesized to mold perceived usability as well as behavioral intentions. Additionally, they posited that an augmentation in experiential learning attenuates the impact of social factors on perceived usefulness and behavioral intentions.

Hu et al. [8], advancing the discourse, presented an intricate synthesis of the TAM. They incorporated two novel dimensions: personal positioning and system adjustment. The former encapsulates constructs like external control perceptions, computer-induced anxiety, computer self-efficacy, and computer playfulness. Conversely, the latter dimension embraces perceived enjoyment and objective usability.

1. Computer self-efficacy: Users' confidence in being able to personally use computers for executing specific work
2. Perceptions of external control: Users perceive the degree of information system support from the organizations and technology support
3. Computer anxiety: Users' worries and fear of unknown conditions when using computers
4. Computer playfulness: Users' perceived interactivity when using computers
5. Perceived enjoyment: Users' joyfulness, in addition to the outcome, of the use of information technology
6. Objective usability: Users compare IT with achieved goals, rather than subjective perception

The following hypotheses are further established:

H1: Perceptions of external control has a positive effect on the perceived user-friendliness.
H6: Students' perceived user-friendliness of distance education has positive impacts on perceived usefulness.
H7: Students' perceived user-friendliness of distance education has positive effects on the attitude to use.
H8: Students' perceived usability of distance education has positive effects on the attitude to use.

2.3 Learning behavior

Yang et al. [9] pointed out learning attitude as the key factor in learning behavior, followed by intrinsic motivation. Learners being able to be satisfied and enjoying the fun in the earning process would maintain the learning motivation for continuous learning. Learning behavior is therefore the standard to judge learning effectiveness and learner satisfaction in learning [10]. Oliveira et al. [11] discussed digital learning behavior with TAM, combining learning motivation theory and TAM, and revealed that TAM could effectively discuss factors in learning behavior and the relationship between attitude towards learning and learning behavior. Rai and Selnes [12] studied the connection between students' attitude toward learning and learning behavior in squash in university PE class and discovered that students with a good learning attitude would enhance learning behavior and acquire higher learning effectiveness.

H9: Students' perceived usability of distance learning education has a positive relationship with their learning behavior.
H10: Students' attitude toward distance education has positive effects on learning behavior.

3 METHODOLOGY

3.1 Conceptual structure of this study

This study integrated information system success model and TAM. These helped in the construction of a new model. The conceptual structure is depicted in Figure 1.
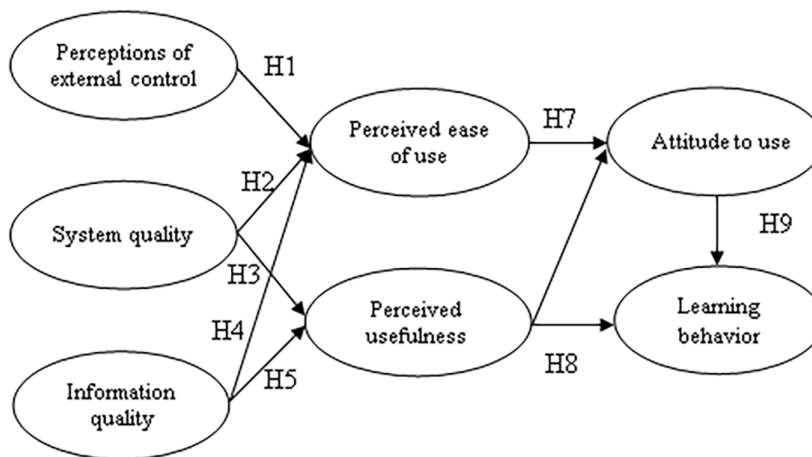

Fig. 1. Conceptual structure

3.2 Sampling

With stratified sampling, the population is divided into two strata based on institutional nature and institutional location. In the first stratum, the population, according to its institutional nature, is classified into national universities and private universities. In the second stratum, the population, according to institutional location, is classified into north, central, and south, referring to universities in northern, central, and southern Taiwan. After confirming the universities, the researcher entrusts the universities to the test with purposive sampling and asks the office staff of academic affairs to averagely distribute samples to students with distinct backgrounds or community participation. Reviewing the retrieved copies of the questionnaire, there are no situations of single gender, class, department, or community participation.

3.3 Questionnaire distribution and retrieval

Students from national universities in Taiwan took part in the research. Copies of the questionnaire were distributed. In the current study, a total of 450 questionnaires were disseminated. Following the exclusion of questionnaires that were either incomplete or deemed invalid, 364 were considered valid, yielding a response rate of 81%. To analyze the collected data and gain insights into students' distance learning behaviors, the Analysis of Moment Structures (AMOS) software was employed.

4 RESULTS ANALYSIS

The findings at the end of the CFA, which stands for confirmatory factor analysis, first ascertain the convergent and discriminant validity of the observational model.

The examination includes evaluating the reliability of individual observed variables, the construct reliability (CR), and the average variance extracted (AVE). The guidelines advocate for an AVE higher than 0.5, with the empirical analysis in this study showing the factor loadings of observed variables exceeding this suggested value. While a CR above 0.6 is generally recommended, some scholars accept a value just above 0.5. In this study, the CR exceeds the 0.5 threshold. Additionally, the AVE for all dimensions assessed surpasses the 0.5 benchmark.

Table 1 clearly shows the calibration findings for the structural equation model. Evaluating the model fit involves examining several indices: the ratio of chi-square to degrees of freedom (χ^2/df), the normed fit index (NFI), the root mean square error of approximation (RMSEA), the root mean square residual (RMR), the goodness of fit index (GFI), and the adjusted goodness of fit index (AGFI). Recommended values for these indices are $\leqq 5$ for χ^2/df, $\leqq 0.08$ for RMSEA, $\geqq 0.9$ for both GFI and AGFI, $\leqq 0.05$ for RMR, and $\geqq 0.9$ for NFI. The indices from this study are in accordance with these suggestions: χ^2/df = 2.688, RMSEA = 0.043, GFI = 0.975, AGFI = 0.934, RMR = 0.02, and NFI = 0.951. These results corroborate a satisfactory overall fit for the model. Moreover, within the context of this optimal model fit, the calibrated parameters of the structural equation, as seen in Table 1, are statistically significant ($p < .05$).

In essence, the results affirm the robustness and reliability of the observational and structural equation models.

Table 1. Structural equation modeling results

Parameter/Evaluation Standard	Coefficient	T
perceptions of external control → perceived user-friendliness	0.151	1.791**
system quality → perceived user-friendliness	0.166	2.136**
system quality → perceived usefulness	0.178	2.896**
information quality → perceived user-friendliness	0.204	3.731***
information quality → perceived useability	0.183	3.327***
perceived ease of use → perceived useability	0.172	2.544***
perceived ease of use → usage attitude	0.213	4.257***
perceived usefulness → usage attitude	0.146	1.458**
attitude to use → learning behavior	0.227	4.866**
χ^2/degree of freedom $\leqq 5$	2.688	
Root mean square error of approximation (RMSEA) $\leqq 0.08$	0.043	
Goodness-of-fit index (GFI) $\geqq 0.9$	0.975	
Adjusted Goodness-of-fit index (AGFI) $\geqq 0.9$	0.934	
Root mean square residual (RMR) $\leqq 0.05$	0.02	
Normed fit index (NFI) $\geqq 0.9$	0.951	

The results from the structural equation modeling substantiate the following hypotheses:

H1: Perceptions of external control has a positive effect on the perceived user-friendliness.

H2: System quality has a positive impact on students' perceived user-friendliness of distance education.

H3: System quality positively affects students' perceived user-friendliness of distance education.

H4: Information quality positively influences students' perceived user-friendliness of distance education.

H5: Information quality positively influences students' perceived usability of distance learning.

H6: Students' perceived user-friendliness of distance education has positive impacts on perceived usefulness.

H7: Students' perceived user-friendliness of distance education has positive effects on the attitude to use.

H8: Students' perceived usability of distance education has positive effects on the attitude to use.

H9: Students' perceived usability of distance learning education has a positive relationship with their learning behavior.

H10: Students' attitude to distance education has positive effects on learning behavior.

In summary, these results highlight the critical role of system and information quality, along with perceptions and attitudes, in determining students' behavior towards distance learning.

5 DISCUSSION

The research analysis results show that students are familiar with the operation of distance learning after learning through it, start to perceive the easy operation, and find out more functions of distance learning to perceive its usefulness. Students, therefore, enjoy using distance learning and consider that distance learning is worth using and could enhance satisfaction with using distance education. It explains that they perceive the user friendliness of distance education because the system design, response time, and display are simple and smooth, with fast responses and few mistakes. Information quality appears to have a secondary impact on perceived user friendliness, revealing that distance education with correct, required, complete, and real-time information would have students perceive ease of use. Both system quality and information quality would affect perceived ease of use [13], which is also affected by not having external support or help [14]. Such results are consistent with past studies on employees' e-learning satisfaction or mobile devices [15]. The larger effect on perceived usefulness shows that students' attitude toward using distance learning lies in the consideration of distance learning being able to assist in learning and have students more rapidly, easily, and efficiently achieve learning goals. Perceived user friendliness could positively impact students' attitudes toward using it because they regard the easy operation of distance learning. When students consider that distance learning can help their learning or is easy to operate, they will enjoy using distance education and enhance their intention of continuously using distance education. Students' learning satisfaction with distance learning is affected by their preference for distance learning and their agreement with distance learning. Students favoring distance learning and feeling the convenience and worthiness would be satisfied with distance learning [16]. Attitude toward use would affect learning satisfaction. The research result is identical to past studies on relevant courses that found that learning attitude would affect learning satisfaction [17].

6 CONCLUSION

According to the research conclusion, in the beginning of using distance learning, students might have problems with the account password for log-in; not understanding the default account password of the universities would fail the log-in with the wrong key-in or account setting [18]. After logging in, they might not find the course due to unfamiliarity with the interface or could not get into the course team because the course was just selected and the data had not been imported [19]. After being able to get into the course, they might not know where to start the video teaching because they do not understand the system design. Students who log in to the app through their mobile phones might encounter the situation that the teacher has started the video teaching while the app does not display the conference to join in and does not know how to solve the problem [20]. After being able to use video teaching, students, due to curiosity, might grope for the functions of distance learning to interfere with the teacher or classmates and result in classmates terminating the video teaching [21]. More resources and assistance are required for distance learning. For this reason, schools being able to provide manuals and operation videos or directly guide students to operate the process of distance learning for classes would help students understand how to have lessons through distance learning and rapidly get used to distance learning. Since the problems are immediately responded to and solved and the skills can be exchanged, teachers or classmates could teach in classes and demonstrate the operation of distance learning. Students with familiarity with the use of distance learning have enhanced their perceived user friendliness, perceived usability, attitude toward using, and learning behavior. According to the relations among perceived user friendliness, perceived usability, attitude toward using, and learning behavior, teachers could attempt to use other functions of distance learning, in addition to video teaching, picture sharing, and whiteboard, and combine them with other software to have students perceive the convenience and usefulness of distance learning, as well as increase students' interests and willingness to use distance learning to further promote the distance learning behavior.

7 REFERENCES

[1] J.-Y. Hsu, C.-C. Chen, and P.-F. Ting, "Understanding MOOC continuance: An empirical examination of social support theory," *Interactive Learning Environments*, vol. 26, no. 8, pp. 1100–1118, 2018. https://doi.org/10.1080/10494820.2018.1446990

[2] S. Altikulaç, M. G. Bos, L. Foulkes, E. A. Crone, and J. van Hoorn, "Age and gender effects in sensitivity to social rewards in adolescents and young adults," *Frontiers in Behavioral Neuroscience*, vol. 13, p. 171, 2019. https://doi.org/10.3389/fnbeh.2019.00171

[3] X. Zheng, J. Men, F. Yang, and X. Gong, "Understanding impulse buying in mobile commerce: An investigation into hedonic and utilitarian browsing," *International Journal of Information Management*, vol. 48, pp. 151–160, 2019. https://doi.org/10.1016/j.ijinfomgt.2019.02.010

[4] L. G. Pee, E. Koh, and M. Goh, "Trait motivations of crowdsourcing and task choice: A distal-proximal perspective," *International Journal of Information Management*, vol. 40, pp. 28–41, 2018. https://doi.org/10.1016/j.ijinfomgt.2018.01.008

[5] A. Bralić and B. Divjak, "Integrating MOOCs in traditionally taught courses: Achieving learning outcomes with blended learning," *International Journal of Educational Technology in Higher Education*, vol. 15, no. 1, pp. 1–16, 2018. https://doi.org/10.1186/s41239-017-0085-7

[6] H.-C. Lin, P. F. Bruning, and H. Swarna, "Using online opinion leaders to promote the hedonic and utilitarian value of products and services," *Business Horizons*, vol. 61, no. 3, pp. 431–442, 2018. https://doi.org/10.1016/j.bushor.2018.01.010

[7] U. Chakraborty, "The impact of source credible online reviews on purchase intention: The mediating roles of brand equity dimensions," *Journal of Research in Interactive Marketing*, vol. 13, no. 2, pp. 142–161, 2019. https://doi.org/10.1108/JRIM-06-2018-0080

[8] X. Hu, X. Chen, and R. M. Davison, "Social support, source credibility, social influence, and impulsive purchase behavior in social commerce," *International Journal of Electronic Commerce*, vol. 23, no. 3, pp. 297–327, 2019. https://doi.org/10.1080/10864415.2019.1619905

[9] S. Yang, H. Jiang, J. Yao, Y. Chen, and J. Wei, "Perceived values on mobile GMS continuance: A perspective from perceived integration and interactivity," *Computers in Human Behavior*, vol. 89, pp. 16–26, 2018. https://doi.org/10.1016/j.chb.2018.07.032

[10] N. H. Khoi, H. H. Tuu, and S. O. Olsen, "The role of perceived values in explaining Vietnamese consumers' attitude and intention to adopt mobile commerce," *Asia Pacific Journal of Marketing and Logistics*, vol. 30, no. 4, pp. 1112–1134, 2018. https://doi.org/10.1108/APJML-11-2017-0301

[11] J. H. Oliveira, B. F. Giannetti, F Agostinho, and C. M. V. B. Almeida, "Decision making under the environmental perspective: Choosing between traditional and distance teaching courses," *Journal of Cleaner Production*, vol. 172, pp. 4303–4313, 2018. https://doi.org/10.1016/j.jclepro.2017.06.189

[12] R. S. Rai and F. Selnes, "Conceptualizing task-technology fit and the effect on adoption – A case study of a digital textbook service," *Information & Management*, vol. 56, no. 8, p. 103161, 2019. https://doi.org/10.1016/j.im.2019.04.004

[13] H. Rafique, A. O. Almagrabi, A. Shamim, F. Anwar, and A. K. Bashir, "Investigating the acceptance of mobile library applications with an extended technology acceptance model (TAM)," *Computers & Education*, vol. 145, p. 103732, 2020. https://doi.org/10.1016/j.compedu.2019.103732

[14] J. B. Abraugh, "How classroom environment and student engagement affecting in internet-based MBA courses," *Business Communication Quarterly*, vol. 63, no. 4, pp. 9–26, 2000. https://doi.org/10.1177/108056990006300402

[15] S. A. Kamal, M. Shafiq, and P. Kakria, "Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM)," *Technology in Society*, vol. 60, p. 101212, 2020. https://doi.org/10.1016/j.techsoc.2019.101212

[16] N. Chintalapati and V. S. K. Daruri, "Examining the use of YouTube as a learning resource in higher education: Scale development and validation of TAM model," *Telematics and Informatics*, vol. 34, no. 6, pp. 853–860, 2017. https://doi.org/10.1016/j.tele.2016.08.008

[17] R. A. Sánchez and A. D. Hueros, "Motivational factors that influence the acceptance of moodle using TAM," *Computers in Human Behavior*, vol. 26, no. 6, pp. 1632–1640, 2010. https://doi.org/10.1016/j.chb.2010.06.011

[18] V. Venkatesh and H. Bala, "Technology acceptance model 3 and a research agenda on interventions," *Decision Sciences*, vol. 39, no. 2, pp. 273–315, 2008. https://doi.org/10.1111/j.1540-5915.2008.00192.x

[19] C. C. Chen and J. L. Tsai, "Determinants of behavioral intention to use the personalized location-based mobile tourism application: An empirical study by integrating TAM with ISSM," *Future Generation Computer Systems*, vol. 96, pp. 628–638, 2019. https://doi.org/10.1016/j.future.2017.02.028

[20] R. Saadé and B. Bahli, "The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model," *Information & Management*, vol. 42, no. 2, pp. 317–327, 2005. https://doi.org/10.1016/j.im.2003.12.013

[21] B. Wu and X. Chen, "Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model," *Computers in Human Behavior*, vol. 67, pp. 221–232, 2017. https://doi.org/10.1016/j.chb.2016.10.028

8 AUTHORS

Meng-Dar Shieh is a Professor in the Department of Industrial Design at National Cheng Kung University, Tainan, Taiwan. Research interests include perceptual computing technologies, computer-aided design and manufacturing, computer animation and simulation and robotic operating systems (E-mail: mdshieh@ncku.edu.tw).

Hsin-Yin Hsieh is a PhD student in the Department of Industrial Design at National Cheng Kung University, Tainan, Taiwan. Research interests include artificial intelligence and industrial design (E-mail: P38094036@ncku.edu.tw).