



# Understanding Augmented Reality Technology Continuance Intention through MARLCardio: A Perspective of Malaysian Higher Institutions Students

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**Abstract:** The current study aims to evaluate the factors that might influence Malaysian higher education students decision to continue using Augmented Reality (AR) technology through Mobile Augmented Reality Learning Cardiovascular (MARLCardio). A self-designed MARLCardio was used as an experimental tool in the process of data collection. Participated students were given a chance to explore AR features in MARLCardio before responding to a survey questionnaire. A total of 459 Malaysian higher institution students from various fields of study participated. Data gathered from the questionnaire was analyzed through Structural Equation Modeling (SEM) using the SmartPLS software. As an outcome of this study, results discovered that attitude is the main factor in determining students continuance intention in use MARLCardio. This study is an addition to the lagging literature on AR technology in the education domain. Moreover, this study also provided information regarding the influencing factors in determining students continuance intention to use AR technology in their learning process. Hence, this study has provided valuable insights for practitioners and scholars.

**Keywords:** *Augmented reality, technology adoption model, structural modeling*

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## I. INTRODUCTION

The development of digital technology has now made major changes to the world and students began to gaze at other learning opportunities by using mobile devices [1]. In past few years, several researchers started exploring the benefits of AR which can be accessed using mobile devices, called Mobile Augmented Reality [2, 3]. AR offers an innovative learning space through an active interaction of superimposing digital content into the real context to enhance learning experiences [4]. Ini-

tially, AR has been widely exposed to the gaming and entertainment industry. However, the great potentials of AR have been discovered in education [5, 6]. Basically, the idea of AR was proposed in 1950s but people started to discover the potential of AR in education after about 51 years in 2009. Within the period, the potential of AR in education remains underexplored [7, 8]. Even if it is explored, it is still at infancy stage in Malaysia [9]. Given these scenario, it is time to see the growth of AR to be implemented in education sector.

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In Malaysia, there are limited published articles reviewing AR in education [10, 11]. In addition, there are also limited published AR sources that can be accessed for learning purposes. AR is exciting to explore as it can enhance a user's impression. The information obtained from the virtual objects helps a user to comprehend more real-world tasks. Due to that reason, there have been some attempts to use AR for training and educational purposes in different scope of study [9, 10, 12]. In addition to the lack of information on AR in education, especially in the local context of Malaysia, there is also insufficient information explaining the predictor factors that might influence students' decision to continue using AR in learning process. It is an important issue to be highlighted for the stability of AR to be used for education purposes. Hence, the present study aims to evaluate the influencing factors of higher institution student's decisions to use AR by using a self-designed MARLCardio as an experimental tool. The discussion in past studies and the lack of information on the use of AR in Malaysia have provided a clear rationale, as well as emphasize the grounds to conduct the present study.

## II. RESEARCH MODEL

This section addresses the hypotheses that have been formulated based on past theories and technology adoption models [13, 14]. The hypotheses used to determine the higher institution students' decision towards the continuance intention of MARLCardio. Attitude (ATT), Social Influences (SI), and Facilitating Conditions (FC) are the independent variables in this study. All these constructs were expected to influence the dependent variables which are Actual Usage (AU) and Continuance Intention (CI).

### A. ATT

In this study, the ATT is defined as the degree to which higher institution students have positive or negative reactions towards the use and continuance intention of MARLCardio. ATT is one of the influencing factors towards proposed technology that already been recognized in Technology Adoption Model (TAM), Theory of Reasoned Action, and Decomposed Planned Theory of Behavior. Previous research found the positive relationship between ATT and AU variables in different contexts of study. As an example, responses from 330 Social Networking Sites (SNS) users show a positive ATT in determining the use of social networking sites [15]. In mobile purchase application context, past researchers found that individual's positive attitude affected their positive decision to purchase on list products [16]. In other

words, individuals' ATT will determine their actions toward the use of proposed technology. Thus, the following hypothesis was designed as:

**H 1a:** *The Malaysian higher institution students' ATT has a significant influence on their AU of MARLCardio in the learning process.*

The individual's intention to continue using a proposed technology will determine the stability of the proposed technology. In mobile shopping service context of the study, finding reported that consumers will continue using mobile shopping service if it satisfies consumer's satisfaction [17]. A similar finding has also been reported in another study in determining continuance intention of proposed technology [18, 19]. Given that an individual's ATT seems to have a direct effect on their CI, the next hypothesis was proposed as:

**H 1b:** *The Malaysian higher institution students' ATT has a significant influence on their CI in using MARLCardio for the learning process.*

### B. SI

The emergent factors that influence an individuals' decision towards technology acceptance have recognized SI as one of the conceivable predictor [20, 21]. People stressed that peers and superiors are the groups of people that closely influence the individuals believe in using certain technology [21]. For the purpose of this study, SI was referred as the extent to which students perceive that other important group of peoples believes that they should continue using MARLCardio in learning process. Drawing on the Unified Theory of Acceptance and Use of Technology (UTAUT) model result in past study indicates that SI is one of the main factors affecting an individual's decision in using proposed technology after they see their colleagues do better at their job [22]. This research finding was further confirmed by Hamari and Koivisto [23] where the study supports the fact that the influence among peers brings large effects towards the use of mobile application in promoting healthy lifestyle. Thus, this present study carries on the subsequent hypothesis:

**H 2a:** *The Malaysian higher institution students' SI has a significant influence on their AU of MARLCardio in the learning process.*

Besides AU, SI also revealed the relationship with the user's continuance intention (CI) of proposed technology. The positive relationship between SI and CI already been proved in previous study when result shows that user's CI towards the usage of Facebook was influenced by their SI factor [18]. In addition, empirical data through survey among college students indicates that SI

as a strong determinant of their decision in using mobile application continuously [19]. Despite that, there is study that did not find the same result [22]. Given inconsistency research findings, this present study, therefore, proposed the next hypothesis as:

**H 2b:** *The Malaysian higher institution students' SI has a significant influence on their CI in using MARLCardio for the learning process.*

### C. Facilitating Condition

Facilitating condition which based on the idea of UTAUT was derived from previously constructs, namely perceived behavior control in the Decomposed Theory of Planned Behavior and Theory of Planned Behavior. FC refers to facilities provided by the authorities in order to expand the use of proposed technology. In this study, FC was defined as the students' perceived level towards the mobile device-assisted to support the use of MARLCardio in learning process continuously. A past study extended the Theory of Reasoned Action to examine the usage of mobile commerce services [24]. Their study found that perceived risk (PR) is a determinant factor towards the use of mobile commerce services. In addition, study by Shang & Wu [17] also reported the same finding, whereas perceived value affected the customer's decision in using mobile shopping services. The PR and PV in both studies bring the same meaning of FC factor. Therefore, this present study tested the following hypothesis:

**H 3a:** *The Malaysian higher institution students' FC has a significant influence on their AU of MARLCardio in the learning process.*

Finding in the previous study reported that the virtuous functionality of e-learning system brings a positive impact towards user's intention to continue using the system [25]. This result was supported in one study, which found that the user's satisfaction in use proposed technology will enhance their intention to use the technology continuously [22]. Based on the justification given, the present study hypothesized that:

**H 3b:** *Malaysian higher institution students' FC has a significant influence on their CI in using MARLCardio for the learning process.*

### D. Actual Use

The actual use of proposed technology as a dependent variable is widely used in order to determine users' acceptance in technology that they used [26, 27]. AU variables also been recognized as an end variable in the UTAUT and TAM. Contradict with Expectation Confirmation Model (ECM) [28]; this model suggested that the cycle of technology adoption should be extended to comprehend user intention to used proposed technology continuously. The result in past study proved that the user's satisfaction in actual use phase affected their positive attitude to continue using the technology [17]. A similar finding claimed that the satisfaction in using proposed technology indirectly raises more users to use it [29]. Therefore, this study hypothesized that:

**H 4:** *The Malaysian higher institution students' AU has a significant influence on their CI in using MARLCardio for the learning process.*

## III. METHODS AND MATERIALS

### A. Participants

A total of 459 higher institution students from public universities in Malaysia were involved in this study. They are students from three different fields of study which are science, social sciences and Technical Vocational Education and Training (TVET).

### B. Data Collection Procedure

A self-designed MARLCardio was used as an experimental tool for the data collection process. It comes in two versions of AR-objects, which are MARLCardio Booklet and MARLCardio Application. Both MARLCardio booklet and MARLCardio app should be used together to gain an AR experience. MARLCardio booklet was distributed to each participant, and then they were asked to download MARLCardio app through Google Play or iOS platform. It is to ensure that all participants had an opportunity to access the AR content in MARLCardio booklet. User can explore the AR content by scanning the marker images that provided in MARLCardio booklet. Fig. 1 shows an AR installation of MARLCardio for better understanding.

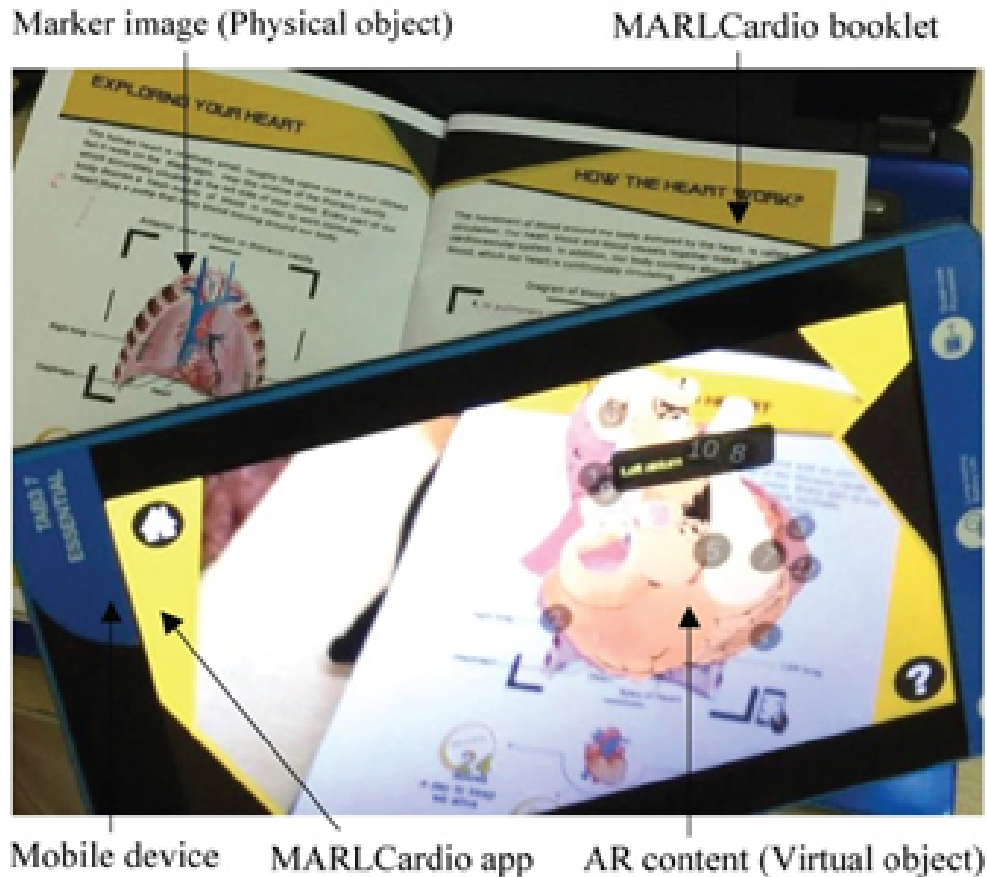


Fig. 1. MARLCardio installation

After exploring the MARLCardio, students were asked to answer a questionnaire through web-based survey. Feedback from the participants is used in order to determine influencing factors towards the continuance intention of MARLCardio.

#### C. Instrument

Questionnaire is the main instrument used to determine the influencing factors towards the continuance intention of MARLCardio. The items in each construct were adopted from reliable sources in previous study. Responses to all items were measured based on four Likert-type of scale ranging from “strongly disagree (1)” to “strongly agree (4)”.

#### D. Data Analysis

Responses of participants to the questionnaire given have been coded into SmartPLS 3.0 software for reliability analysis and path coefficients analysis. Path coefficients analysis was used to determine the acceptance or rejection of hypothesis.

## IV. FINDINGS

### A. Reliability Analysis

Reliability analysis was conducted to determine the internal consistency reliability coefficients for each item in constructed variables. Reliability analysis was tested by using Cronbach’s alpha. Results of reliability analysis in Table 1 presented confirmatory evidence that those constructs are reliable as the value is exceeding the recommended value of 0.70 [30].

TABLE 1  
THE CRONBACH’S ALPHA VALUE

Variables	Cronbach’s Alpha
Attitude (ATT)	0.891
Social Influences (SI)	0.893
Facilitating Conditions (FC)	0.846
Actual usage (Au)	0.878
Continuance Intention (CI)	0.889

### B. Research Hypotheses

The main focus of this section is to explore the relationship in developing structural model. As PLS-SEM

is primarily used to develop theories in exploratory research, then it is seen as an appropriate method to apply. Prior to testing the model, all the variables are drawn depending on their possible relationship. To begin with, the PLS bootstrapping was analyzed to determine the empirical  $t$ -statistic value and its corresponding  $p$ -value for significant testing. Following this, the PLS algorithm was analyzed in order to obtain the path coefficient that explains the relationship between a possible relationship. The  $t$ -statistic,  $p$ -value and path coefficient values can be found in Table 2.

Besides, the  $R^2$  value also has been calculated in explaining the amount of variance in the dependent

variable explained by all of the independent variables linked to it. As a result of path coefficients, data revealed that ATT ( $p = 0.002$ ) and SI ( $p = 0.048$ ) are predictors in determining higher institution students' AU of MARLCardio while FC ( $p = 0.307$ ) does not shows any significant relationship. Therefore, the H1a and H2a was supported. Results also indicates that ATT ( $p = 0.001$ ) and FC (0.033) had a positive relationship with the CI of MARLCardio in directly without going through AU as a mediating variable. Hence, the H1b and H3b hypotheses were supported. On the other hand, statistical outcomes caused the exclusion of SI and AU as predictors towards CI of MARLCardio due to the higher number of  $p$ -value.

TABLE 2  
STATISTIC OUTPUT

Hypotheses	Hypothesized Path	$t$ Statistics	Path coefficient	$p$ value	Accepted /Rejected
H1a	ATT > AU	3.053	0.183	0.002	Accepted
H1b	ATT > CI	3.256	0.293	0.001	Accepted
H2a	SI > AU	1.975	0.092	0.048	Accepted
H2b	SI > CI	0.084	0.006	0.933	Rejected
H3a	FC > AU	1.021	0.074	0.307	Rejected
H3b	FC > CI	2.129	0.249	0.033	Accepted
H4	AU > CI	1.640	0.177	0.102	Rejected

The structural models in determining the CI of higher institution students in using AR through MARLCardio are revealed in Fig. 2. The statistical output of  $R^2$  represents values for any predicted variables. Data indi-

cates that 54.1% variance in AU that can be explained by ATT and SI. Additionally, two predicted variables which are ATT and FC explain 47.6 % of the variance in CI.

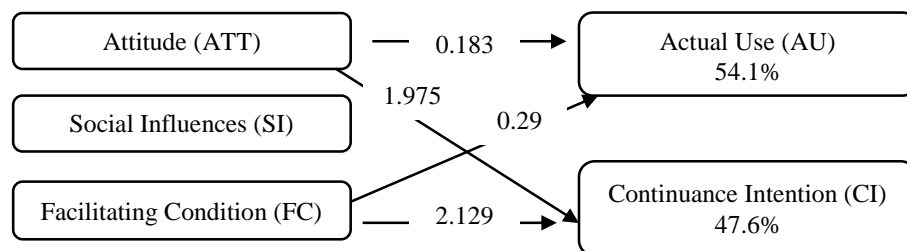


Fig. 2. Structural model in explaining the CI of MARLCardio.

## V. CONCLUSION AND RECOMMENDATIONS

The present paper aims to validate the factors affecting higher institution student's decision in using AR for learning purposed through MALRCardio. The result revealed that ATT and SI are important variables that will determine the use of AR. On other hand, in determining the CI of MARLCardio, ATT and FC play the biggest roles. Although AR is still at a fancy stage in Malaysia, but it has proven that AR can easily be adapted since there is a positive relationship between ATT and CI. In

other word, students who have a positive reaction towards MARLCardio will keep continue using it for learning purpose. At the same time, a complete facility also help to encourage student to keep using MARLCardio.

In order to get a better understanding of explaining CI of AR, further research can be conducted by adding more possible predictors such as performance expectancy and effort expectancy variables as drawn in TAM model. In addition, higher institution students experience in using AR can also be considered as a moderator since

there are past studies that confirmed the positive moderating effect. Considering the nature of AR technology in Malaysia, the exposure is still at initial process especially in an education setting. Hence, further research of AR in education should be widely explored.

### Declaration of Conflicting Interests

There are no conflicting interests in this study.

### REFERENCES

- [1] I. Ismail, S. N. Azizan, and T. Gunasegaran, "Mobile learning in Malaysian universities: Are students ready?" *International Journal of Interactive Mobile Technologies (IJIM)*, vol. 10, no. 3, pp. 17–23, 2016. doi: <https://doi.org/10.3991/ijim.v10i3.5316>
- [2] N. Chung, H. Lee, J.-Y. Kim, and C. Koo, "The role of augmented reality for experience-influenced environments: The case of cultural heritage tourism in Korea," *Journal of Travel Research*, vol. 57, no. 5, pp. 627–643, 2018. doi: <https://doi.org/10.1177/0047287517708255>
- [3] H. F. bin Hanafi, C. S. Said, A. H. Ariffin, N. A. Zainuddin, and K. Samsuddin, "Using a Collaborative Mobile Augmented Reality Learning Application (CoMARLA) to improve improve student learning," *IOP Conference Series: Materials Science and Engineering*, vol. 160, pp. 1–9, 2016. doi: <https://doi.org/10.1088/1757-899x/160/1/012111>
- [4] R. T. Azuma, "A survey of augmented reality," *Presence: Teleoperators & Virtual Environments*, vol. 6, no. 4, pp. 355–385, 1997. doi: <https://doi.org/10.1162/pres.1997.6.4.355>
- [5] K.-F. Lee, M.-S. Wu, H.-C. Hsieh, and K.-Y. Chin, "Augmented reality supported mobile self-guided system for enhancing authentic learning activities," *International Journal of Cognitive Performance Support*, vol. 1, no. 2, pp. 117–131, 2018. doi: <https://doi.org/10.1504/IJCPS.2018.093079>
- [6] R. Wojciechowski and W. Cellary, "Evaluation of learners' attitude toward learning in ARIES augmented reality environments," *Computers & Education*, vol. 68, pp. 570–585, 2013. doi: <https://doi.org/10.1016/j.compedu.2013.02.014>
- [7] Á. Di Serio, M. B. Ibáñez, and C. D. Kloos, "Impact of an augmented reality system on students' motivation for a visual art course," *Computers & Education*, vol. 68, pp. 586–596, 2013. doi: <https://doi.org/10.1016/j.compedu.2012.03.002>
- [8] F. B. A. Rauf, T. W. Hoe, and K. B. Samsudin, "A framework of educational augmented reality app for improving preschoolers creative thinking," *International Journal of Technology and Engineering Studies*, vol. 1, no. 2, pp. 31–41, 2015. doi: <https://doi.org/10.20469/ijtes.40001-2>
- [9] J. E. Mat-Jizat, J. Osman, R. Yahaya, and N. Samsudin, "The use of Augmented Reality (AR) among tertiary level students: Perception and experience," *Australian Journal of Sustainable Business and Society*, vol. 2, no. 1, pp. 42–49, 2016.
- [10] N. A. M. Lazim and K. A. A. Rahman, "State-of-the-art responses on augmented reality application in Malaysia," *International Journal on Sustainable Tropical Design Research and Practice*, vol. 8, pp. 28–34, 2015.
- [11] N. A. A. Majid and N. K. Husain, "Mobile learning application based on augmented reality for science subject: Isains," *ARPN Journal of Engineering and Applied Sciences*, vol. 9, no. 9, pp. 1455–1460, 2014.
- [12] K. R. Allen, "Building bridges between the virtual and real: A study of augmented and virtual realities in the museum space and the collaborations that produce them," Unpublished doctoral dissertation, University of California, Los Angeles, CA, 2016.
- [13] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, vol. 13, no. 3, pp. 319–340, 1989. doi: <https://doi.org/10.2307/249008>
- [14] Venkatesh, Thong, and Xu, "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology," *MIS Quarterly*, vol. 36, no. 1, pp. 157–178, 2012. doi: <https://doi.org/10.2307/41410412>
- [15] Y. W. Ha, J. Kim, C. F. Libaque-Saenz, Y. Chang, and M.-C. Park, "Use and gratifications of mobile SNSs: Facebook and KakaoTalk in Korea," *Telematics and Informatics*, vol. 32, no. 3, pp. 425–438, aug 2015. doi: <https://doi.org/10.1016/j.tele.2014.10.006>
- [16] L. Gao, K. A. Waechter, and X. Bai, "Understanding consumers' continuance intention towards mobile purchase: A theoretical framework and empirical study - a case of China," *Computers in Human Behavior*, vol. 53, pp. 249–262, 2015. doi: <https://doi.org/10.1016/j.chb.2015.07.014>
- [17] D. Shang and W. Wu, "Understanding mobile shopping consumers' continuance intention," *Industrial Management & Data Systems*, vol. 117, no. 1, pp. 213–227, feb 2017. doi: <https://doi.org/10.1108/imds-02-2016-0052>
- [18] S. Mouakket, "Factors influencing continuance intention to use social network sites: The facebook

- case,” *Computers in Human Behavior*, vol. 53, pp. 102–110, 2015. doi: <https://doi.org/10.1016/j.chb.2015.06.045>
- [19] C.-H. Hsiao, J.-J. Chang, and K.-Y. Tang, “Exploring the influential factors in continuance usage of mobile social apps: Satisfaction, habit, and customer value perspectives,” *Telematics and Informatics*, vol. 33, no. 2, pp. 342–355, 2016. doi: <https://doi.org/10.1016/j.tele.2015.08.014>
- [20] I. Ajzen, “The theory of planned behavior,” *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, pp. 179–211, 1991. doi: [https://doi.org/10.1016/0749-5978\(91\)90020-t](https://doi.org/10.1016/0749-5978(91)90020-t)
- [21] S. Taylor and P. A. Todd, “Understanding information technology usage: A test of competing models,” *Information Systems Research*, vol. 6, no. 2, pp. 144–176, 1995. doi: <https://doi.org/10.1287/isre.6.2.144>
- [22] É. Maillet, L. Mathieu, and C. Sicotte, “Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an electronic patient record in acute care settings: An extension of the UTAUT,” *International Journal of Medical Informatics*, vol. 84, no. 1, pp. 36–47, 2015. doi: <https://doi.org/10.1016/j.ijmedinf.2014.09.004>
- [23] J. Hamari and J. Koivisto, “Working out for likes: An empirical study on social influence in exercise gamification,” *Computers in Human Behavior*, vol. 50, pp. 333–347, 2015. doi: <https://doi.org/10.1016/j.chb.2015.04.018>
- [24] J. Lin, B. Wang, N. Wang, and Y. Lu, “Understanding the evolution of consumer trust in mobile commerce: A longitudinal study,” *Information Technology and Management*, vol. 15, no. 1, pp. 37–49, 2014. doi: <https://doi.org/10.1007/s10799-013-0172-y>
- [25] J.-C. Hong, K.-H. Tai, M.-Y. Hwang, Y.-C. Kuo, and J.-S. Chen, “Internet cognitive failure relevant to users’ satisfaction with content and interface design to reflect continuance intention to use a government e-learning system,” *Computers in Human Behavior*, vol. 66, pp. 353–362, 2017. doi: <https://doi.org/10.1016/j.chb.2016.08.044>
- [26] H.-J. Lai, “Examining civil servants’ decisions to use web 2.0 tools for learning, based on the decomposed theory of planned behavior,” *Interactive Learning Environments*, vol. 25, no. 3, pp. 295–305, 2017. doi: <https://doi.org/10.1080/10494820.2015.1121879>
- [27] E. Ahmed and R. Ward, “A comparison of competing technology acceptance models to explore personal, academic and professional portfolio acceptance behaviour,” *Journal of Computers in Education*, vol. 3, no. 2, pp. 169–191, 2016. doi: <https://doi.org/10.1007/s40692-016-0058-1>
- [28] A. Bhattacharjee, “Understanding information systems continuance: An expectation-confirmation model,” *MIS Quarterly*, vol. 25, no. 3, pp. 351–370, 2001. doi: <https://doi.org/10.2307/3250921>
- [29] H.-W. Kim, S. Gupta, and Y.-S. Jeon, “User continuance intention towards mobile internet service: The case of WiMAX in Korea,” *Journal of Global Information Management*, vol. 21, no. 4, pp. 121–142, 2013. doi: <https://doi.org/10.4018/jgim.2013100107>
- [30] G. White, D. Cordato, F. O’Rourke, R. Mendis, D. Ghia, and D. Chan, “Validation of the stroke rehabilitation motivation scale: A pilot study,” *Asian Journal of Gerontology & Geriatrics*, vol. 7, no. 2, pp. 80–87, 2012.