Learning from anywhere, anytime: Utilitarian motivations and facilitating conditions for mobile learning

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Abstract
This contribution investigates higher education students’ perceptions about mobile learning (m-learning) applications, as well as the effects of social influences and of appropriate facilitating conditions, on their intentions to continue using them. A structured survey questionnaire integrated valid measures from the Technology Acceptance Model (TAM) and from the Unified Theory of Acceptance and Use of Technology (UTAUT) to better explain their acceptance and use of m-learning software. The findings reported that facilitating conditions including the provision of resources, ongoing training opportunities and technical support, were affecting the respondents’ engagement with m-learning programs. The respondents indicated that they were not influenced by others to use mobile technologies for educational purposes. The results also suggest that they were well acquainted (and habituated) with the use of mobile devices and their applications. Evidently, they helped them improve their learning journeys.

Keywords Technology acceptance · Mobile applications · Mobile learning · Social influences · Facilitating conditions · Higher education

1 Introduction

Previous studies relied on reliable measures that were drawn from key theoretical underpinnings from information systems, marketing or psychology literature to investigate the
students’ perceptions on the utilization of educational technologies (Almaiah & Alismaiel, 2019; Camilleri & Camilleri, 2021; Casey et al., 2020; Dlab et al., 2020; Dreimane & Daniela, 2020; Yang et al., 2019). A number of contributions examined the students’ engagement with mobile applications (apps) in higher education (Crompton & Burke, 2018; Nguyen et al., 2015; Park et al., 2012; Sevillano-Garcia & Vázquez-Cano, 2015). Very often, academic researchers discussed about their benefits and costs (Camilleri & Camilleri, 2017a; Chang et al., 2018; Dreimane & Daniela, 2020; Gialamas, Lavidas & Komis, 2021; Jahnke et al., 2020; Lameu, 2020; Nikolopoulou, Swanson, 2020).

The majority of higher education students have their own mobile devices. They can use them to access educational content, whenever and wherever they are, as long as they are connected to the Internet (Al-Emran et al., 2016; Chang et al., 2018; Sevillano-Garcia & Vázquez-Cano, 2015). Therefore, they can use mobile technologies, at their convenience, to access learning management systems, course notes, recorded videos, assessments, quizzes, games, etc. These devices also allow their users to connect to conferencing software like Zoom or Microsoft Teams to interact with others, including with their course instructor, in real time (Camilleri & Camilleri, 2022).

There are different factors that can influence the mobile learners’ (m-learners’) readiness to utilize m-learning apps in higher education contexts (Crompton & Burke, 2018; Furió et al., 2015; Hamidi & Chavoshi, 2018; Sung et al., 2016). This study builds on the extant literature in academia as it explores the university students’ perceptions and attitudes on their acceptance and use of mobile technologies (Bokolo, Kamaludin, Romli, Raffei, Phon, Abdullah & Ming, 2020; Casey et al., 2020; Lameu, 2020; Nikolopoulou et al., 2021; Swanson, 2020; Zogheib & Daniela, 2021). Furthermore, it investigates the effects of the respondents’ social influences as well as of their institution’s facilitating conditions on their intentions to continue utilizing m-learning technologies.

There are several studies that validated technology adoption models. Many authors have adapted Davis, Warshaw and Bagozzi’s (1989) technology acceptance model (TAM) (Dumpit & Fernandez, 2017; Granić & Marangunić, 2019; Scherer et al., 2019) or Venkatesh, Morris, Davis and Davis’ (2003) unified theory of acceptance and use of technology (UTAUT/UTAUT2) (Gunasinghe et al., 2019; Nistor et al., 2014; Tosuntaş et al., 2015; Yang et al., 2019), among others, in different settings. They used TAM to explore the users’ perceptions on the usefulness and the ease of use of technologies. Very often they found that these factors have a significant effect on their intentions to use them (Almaiah & Alismaiel, 2019; Camilleri & Camilleri, 2019a; Chavoshi & Hamidi, 2019). Similarly, others relied on the UTAUT/UTAUT2 theoretical frameworks to investigate the effects of performance and effort expectancies, social influences and facilitating conditions on technology adoption (Almaiah et al., 2019; Camilleri & Camilleri, 2019b).

For the time being, there are no other contributions in academia, that integrated perceived ease of use, perceived usefulness and attitudes (from TAM) with social influences and facilitating conditions constructs (from UTAUT), to shed light on higher education students’ utilitarian motivations to use m-learning apps. Therefore, this research clarifies whether the research participants were pressurized by course instructors or by their peers to make use of these ubiquitous technologies. At the same time, it investigates their perceptions about the provision of ongoing support, resources and infrastructures (e.g. appropriate WiFi facilities, at home and at university) that are intended to facilitate their engagement with m-learning technologies.
2 Literature review

Mobile devices are portable technologies that can be used in different locations when students and educators, are out and about (Camilleri & Camilleri, 2019a; Callaghan, 2018). Students can utilize mobile devices as instruments to improve the quality of their education (Fokides, Atsikpasi & Karageorgou, 2020; Moya & Camacho, 2021; Nikolopoulou, Gialamas, Lavidas & Komis, 2021). They may avail themselves of ubiquitous technologies to enhance their knowledge across multiple contexts, through social and content interactions (Crompton, 2013). There are a number of potential benefits that are derived from m-learning technologies (Chang et al., 2018). Their educational apps can play a significant, supplemental role in the in improving the learning outcomes of students (Butler, Camilleri, Creed & Zutshi, 2021).

M-learning apps enable students to access and revise their course material from virtually everywhere. They provide access to rich sources of information via the Internet including to asynchronous learning management systems like Blackboard and Moodle, among others. (Camilleri & Camilleri, 2017a; Bergdahl & Nouri, 2020; Dlab et al., 2020; Kuznetcova, Lin & Glassman, 2021).

They also offer synchronous learning opportunities if users install video conferencing programs including Skype, Google Meet, Zoom and Microsoft Teams (Camilleri & Camilleri, 2021a; 2022). Course participants may use mobile apps to interact with other online users in collaborative learning settings, including with their course instructor (Maqtary, Mohsen & Bechkoum, 2019). This allows them to apply their theoretical knowledge in an authentic context (i.e. in situated and informal learning contexts), as they are expected to engage in online communications (Kwong, Wong & Yue, 2017). Therefore, conferencing programs can be used to organize virtual meetings with students in real time (Nikolopoulou et al., 2021).

Nevertheless, previous literature reported that not all students are willing to utilize their mobile phones or tablets for educational purposes (Casey et al., 2020; Zogheib & Daniela, 2021). A few commentators argued that smart phones have small screens with low resolutions, slow connection speeds, and lacked standardization options (Al-Furaih & Al-Awidi, 2020; Lowenthal, 2010). In fact, Android, Apple and Microsoft Windows have their own operating systems. As a result, m-learning applications have to be programmed or customized to be compatible with these systems (Camilleri & Camilleri, 2021).

Some commentators contended that individuals may possess different attitudes on the usage of the mobile technologies (Al-Emran et al., 2016). There are individuals who may hold different opinions and perspectives on the use mobile technologies (Ciampa, 2014). They may be willing to utilize these devices to keep in contact with their friends on social media, to listen to their preferred music, or to watch video clips and live streaming (Park et al., 2012). They may use their mobile devices for hedonic and entertainment purposes, rather than to participate in learning activities.

Many academic researchers laid out their recommendations on how to plan, organize and implement the use of mobile apps across different levels of education (Butler et al., 2021; Camilleri & Camilleri, 2017b; Crompton & Burke, 2018; Hwang & Chang, 2011). M-learning is highly relevant in tertiary levels of education, as higher education students will probably have their own mobile devices (Sevillano-Garcia & Vázquez-Cano, 2015).
| Construct                  | Source                                                                 | Definition                                                                                                                                                                                                 |
|----------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Perceived ease of use**  | Technology Acceptance Model (Davis, 1989; Davis et al., 1989).          | Perceived ease of use refers to the degree to which individuals expect technologies to be simple to use, as they are straightforward and free of effort.                                                    |
| **Perceived usefulness**   | Technology Acceptance Model (Davis, 1989; Davis et al., 1989).          | Perceived usefulness refers to the individuals’ beliefs about the utilitarian value of technologies.                                                                                                    |
| **Attitudes**              | Technology Acceptance Model (Davis, 1989; Davis et al., 1989).          | Attitudes refer to the individuals’ positive or negative feelings about performing target behaviors (like using technologies).                                                                       |
| **Social influences**      | Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). | Social influences refer to the degree to which individuals believe that they can be influenced by the presence or actions of other persons.                                                             |
| **Facilitating conditions**| Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). | Facilitating conditions is defined as the degree to which individuals believe that they can avail themselves of technical resources, knowledge and support from others (to use technologies). |
| **Intentions**             | ‘Behavioral intention’ construct – from Technology Acceptance Model (Davis, 1989; Davis et al., 1989). Theory of Reasoned Action (Ajzen & Fishbein, 1975). Theory of Planned Behavior (Ajzen, 1991). | Intentions refer to the individuals’ willingness to perform specified behaviors (like using technologies).                                                                                             |
| **Engagement**             | ‘Actual system use’ construct – from Technology Acceptance Model (Davis, 1989; Davis et al., 1989). ‘Actual behavior’ construct – from Theory of Reasoned Action (Ajzen & Fishbein, 1975). Theory of Planned Behavior (Ajzen, 1991). | Behaviors refer to actions (like using/engaging with technologies).                                                                                                                                      |
Currently, there is still limited research that investigates the university students’ willingness to use educational apps through their mobile devices (Camilleri & Camilleri, 2022; Jahnke et al., 2020), although there are a number of contributions that have explored the students’ or educators’ perceptions toward other media, including digital learning resources, WebCT or Moodle systems, in different contexts (Granić & Marangunić, 2019; Scherer et al., 2019). Such academic studies have often relied on theoretical frameworks that are focused on the utilitarian motivations to use technology in the realms of education (Al-Furaih & Al-Awidi, 2020; Bokolo, Kamaludin, & Romli, 2021; Briz-Ponce, Pereira, Carvalho, Juanes-Méndez & García-Peñalvo, 2017; Tosuntas et al., 2015).

### 3 Key theoretical underpinnings and the formulation of hypotheses

Various researchers have often relied on technology adoption models including TAM/TAM2/TAM3 or UTAUT/UTAUT2, among others, to investigate the acceptance and use of technologies (Camilleri & Camilleri, 2022; Nikou & Economides, 2017; Schoonenboom, 2014). Table 1 clarifies the meanings of the constructs that are used for this empirical research.

#### 3.1 The technology acceptance model

Davis (1989) suggested that the individuals’ intentions would usually anticipate their actual behaviors. He argued that their intentions towards using technologies would usually precede their actual utilization. The theory of reasoned action also presumed that the persons’ behavioral intentions would anticipate their actions (Ajzen, 1991). Many academic commentators reiterated that intentions are assumed to capture the motivational factors that influence specific behaviors (Camilleri & Camilleri, 2017c). Ajzen (1991) contended that the stronger the individuals’ intentions to engage in volitional behaviors, the more likely they will perform their actions. Arguably, the persons’ intentions represent their actual control over certain behaviors; to the extent that when an opportunity arises, if they have access to certain resources, they will be in a better position to engage in their desired activities (Camilleri & Camilleri, 2019b). Therefore, the individuals’ intentions to use m-learning technologies is a potential antecedent for their active engagement with them. This argumentation leads to the first hypothesis:

**H1:** The students’ intentions to use m-learning apps positively affects their active engagement with them.

Individuals may think that the technologies would be easy to use, user friendly or free of effort (Davis, 1989). Individuals will probably engage with technologies if they perceive them as uncomplicated and easy to understand (Joo, Park & Lim, 2018; Camilleri & Camilleri, 2017a). TAM researchers noted that the perceived ease of use of technology is a precursor of their perceived usefulness (Faqih & Jaradat 2015; Scherer et al., 2019). Very often, they argued that individuals are more likely to use those technologies that are simple and straightforward to use. In addition, many researchers including Teo (2009), Huang, Huang, Huang and Lin (2012) as well as Siyam (2019) reported that the respondents’ perceived ease of use of technology was
significantly affecting their positive attitudes towards them. Hence, this study hypothesizes the following:

H2: The students’ perceived ease of use of m-learning apps positively affects their perceived usefulness.

H3: The students’ perceived ease of use of m-learning apps positively affects their attitudes towards them.

Alternatively, individuals may believe that certain technologies are difficult to understand and use (Scherer et al., 2019). They may feel uncomfortable with the use of technological innovations if they consider them as time consuming and/or complicated. In these cases, they will probably hold negative perceptions towards such technologies. Thong Hong and Tam (2002) reported that there may be a negative relationship between the use of complex technologies and their perceived usefulness.

Individuals will probably use technologies to enhance the quality of their work or job performance (Camilleri, 2020a; Camilleri, 2021a; Cheon et al., 2012; Davis, 1989; Garcia & Silva, 2017). They may perceive that some technologies are useful for them, particularly if they help them increase their productivity. In this case, this research sought to explore whether the use of m-learning technologies would support students to achieve their learning outcomes. It investigates the respondents’ attitudes towards educational apps. Previous literature indicated that there a significant relationship between the students’ perceptions about the usefulness of technologies and their attitudes towards them Camilleri & Camilleri 2017a; Siyam, 2019; Teo et al., 2016). The researchers hypothesize that if the students perceive their usefulness, they will probably hold positive attitudes towards them. Therefore, this research hypothesizes:

H4: The students’ perceived usefulness of m-learning apps positively affects their attitudes toward them.

TAM theorists postulated that the individuals’ positive attitudes toward technology can have a significant effect on their acceptance (Huang et al., 2012; Ngai et al., 2007; Thong Hong & Tam, 2002). A number of researchers relied on Ajzen’s (1991) theory of planned behavior’s (TPB’s) key constructs, reported that the individuals’ positive attitudes toward the usage of technology would precede their intentions to continue using them in the future (Cheon et al., 2012; Teo et al., 2016). This argumentation leads to the following hypothesis:

H5: The students’ attitudes toward m-learning apps positively affects their intentions to use them.

Of course, there may be instances where individuals will not always hold positive attitudes toward technologies. Many studies, including Davis (1989) indicated that the individuals’ attitudes towards the use of technology did not emerge as a very significant antecedent of the individuals’ technology acceptance. In a similar vein, other researchers also reported that the individuals’ attitudes towards technology did not always correlate with their intentions to use them (Nikou & Economides, 2017). One of the most plausible reasons for this is that many individuals may be expected to use certain technologies as a requirement for their work performance, whether they like them or not (Camilleri & Camilleri, 2022).
3.2 The unified theory of acceptance and use of technology

TAM has been adapted by various scholars. Venkatesh et al., (2003) unified theory of acceptance and use of technology (UTAUT) as well Venkatesh, Thong & Xu’s (2012) (UTAUT2) have included various elements from Davis’ (1989) TAM. Venkatesh et al., (2003; 2012) also incorporated a ‘social influences’ factor in their theoretical models. The social influences construct is synonymous with Ajzen and Fishbein’s (1975) and Ajzen’s (1991) ‘subjective norm’. In sum, these authors argued that individuals may be influenced by others, including by their family members, friends or even by acquaintances, to use certain technologies. The normative pressures from society can have a significant effect on the individuals’ intentions to perform certain behaviors (Ajzen, 1991; Bokolo et al., 2021; Camilleri, 2020; Park et al., 2012). In this case, the researchers presume that course instructors or other persons including the students’ peers can influence their intentions to use mobile learning apps. Hence, the researchers hypothesize:

H6: The social influences positively affect the students’ intentions to use m-learning apps.

![Diagram of Factors affecting the students’ engagement with m-learning programs](image-url)
Venkatesh et al. (2003) also included a ‘facilitating conditions’ construct in UTAUT. They justified the inclusion of this factor as they wanted to measure their research participants’ perceptions on physical environmental features (e.g. infrastructures and equipment) and intangible aspects (like training and development, or the provision of ongoing support and assistance to technology users, among others). Venkatesh et al. (2003) contended that facilitating conditions significantly affect the individuals’ intentions as well as their actual engagement with technologies.

Similarly, many researchers reported that facilitating conditions were influencing the students’ intentions to use education technologies (García Botero, Questier, Cincinnato, He & Zhu, 2018; Peñarroja, Sánchez, Gamero, Orengo & Zornoza, 2019; Thomas, Singh & Gaffar, 2013). Others noticed that they had an impact on their actual behaviors (Gunasinghe et al., 2019). Thus, the researchers hypothesize that:

H7: The facilitating conditions positively affect the students’ intentions to use m-learning apps.

H8: The facilitating conditions positively affect the students’ usage of m-learning apps.

Figure 1 illustrates the research model and the formulation of hypotheses. It explores the effects of the students’ utilitarian motivations, social influences and facilitating conditions on their acceptance and usage of m-learning programs.

In sum, this research hypothesizes that there are positive and significant relationships between the students’ perceived ease of use and perceived usefulness of m-learning technologies and between their attitudes and intentions to continue using them. It presumes that facilitating conditions are significantly correlated with the students’ willingness to use them, as well as with their active engagement with them. In addition, this study theorizes that the respondents were, in some way, influenced (by their course instructor and/or by their peers) to utilize these m-learning programs to continue their learning journeys.

4 Methodology

4.1 The questionnaire’s measures

The survey’s measures were adapted from key theoretical underpinnings. ‘Perceived usefulness’, ‘perceived ease of use’ and ‘attitudes toward technology’ were drawn from TAM’s basic model (Camilleri & Camilleri, 2017b; Cheung & Vogel, 2013; Davis, 1989). The users’ ‘attitudes toward technology’ construct was also featured in TPB (Park et al., 2012; Shonfeld & Magen-Nagar, 2020). Moreover, ‘social influences’ and ‘facilitating conditions’ constructs were used in UTAUT/UTAUT2 models (Camilleri, 2020; Camilleri & Camilleri, 2022; Bokolo et al., 2020; Bokolo et al., 2021; Venkatesh et al., 2003; 2012).

Davis (1989) reported that his TAM constructs were reliable. He indicated that the Cronbach Alpha values were above 0.90. His analysis also confirmed that these constructs had appropriate convergent and discriminant validities. Other studies yielded similar validity and reliability values as many researchers explored the use and acceptance of different
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Technologies in various contexts (Park et al., 2012; Teo & Zhou, 2014). Venkatesh et al. (2012) found that their UTAUT constructs had internal consistency values that exceeded 0.75 (these figures were higher than the recommended threshold of 0.7). They held that their convergent and discriminant validity results were consistent with previous research. The constructs that were adopted in the survey instrument are featured in Table 2.

The questionnaire consisted of 26 multiple choice questions including three demographic ones, that were placed in the latter part of the survey. The participants disclosed information about their ‘age’ and ‘gender’. They also indicated their ‘experience with m-learning technologies’. The respondents could complete the questionnaire in a few minutes. The responses were coded on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with 3 signaling a neutral position.

| Construct                  | Items                                                                 |
|----------------------------|----------------------------------------------------------------------|
| Perceived ease of use      | PEoU1 Learning how to use mobile learning technologies is easy for me. |
|                            | PEoU2 My interaction with mobile learning technologies is clear and understandable. |
|                            | PEoU3 I find mobile learning technologies easy to use.                |
|                            | PEoU4 It is easy for me to become skillful at using mobile learning technologies. |
| Perceived usefulness       | PU1 The mobile learning technologies are useful in my daily life.     |
|                            | PU2 The mobile learning technologies increase my chances of achieving things that are important to me. |
|                            | PU3 The mobile technologies help me learn things more quickly.        |
|                            | PU4 The mobile learning technologies increase my productivity.        |
| Attitudes                  | ATT1 Using the mobile learning technologies is frustrating for me. (R) |
|                            | ATT2 I get bored quickly when I use the mobile learning technologies. (R) |
| Social influences          | SI1 People who are important to me think that I should use mobile learning technologies. |
|                            | SI2 People who influence my behavior think that I should use mobile learning technologies. |
|                            | SI3 People whose opinions that I value prefer that I use mobile learning technologies. |
| Facilitating conditions    | FC1 I have the resources necessary to use mobile learning technologies. |
|                            | FC2 I have the knowledge necessary to use mobile learning technologies. |
|                            | FC3 I can get help from others when I have difficulties using mobile learning technologies. |
|                            | FC4 The mobile learning technologies are compatible with other technologies I use. |
| Intentions                 | INT1 It is very likely that I shall continue using mobile learning technologies in the future. |
|                            | INT2 Probably, I will use mobile learning technologies in my daily life. |
|                            | INT3 I will use mobile learning technologies as frequently as possible. |
| Engagement                 | ENG1 I use mobile learning technologies to browse the web.            |
|                            | ENG2 I search for information with mobile learning technologies.       |
|                            | ENG3 I use educational apps on my mobile device (smartphone or tablet). |
4.2 Data capture and analysis

The research participants were registered students at a Southern European university. There were more than 10,500 students who were pursuing full time, part time and distance learning courses. The university’s registrar disseminated this study’s survey questionnaire and a cover letter that informed the research participants about the aims and objectives of this empirical investigation. It also provided them with guidelines on how to complete the questionnaire. After two weeks, there were 141 responses to the survey. The returned questionnaires were scrutinized and checked for incomplete responses. There were three questionnaires that were not included in the analysis as they had several missing values. Hence, the research sample of this study comprised 138 valid responses.

The data were uploaded onto IBM SPSS statistical software. The researchers evaluated the socio-demographic profile of their respondents and explored the descriptive statistics. They indicated the reliability of their constructs. Moreover, they carried out a principal component analysis (PCA) to reduce the dimensionality of the dataset, and to detect the underlying structure among the measures. PCA also confirmed the validity of the chosen measures. Only factor loadings that were above the 0.5 benchmark were considered in the analyses. Subsequently, this study’s hypotheses were investigated through stepwise regression analyses (that shed light on the coefficients of determination and on the significance of the relationships).

5 Results

5.1 The research sample
The frequency table reported that there were seventy-five females and sixty-three males (n = 138) who participated in this study. The respondents were classified into five age groups (18–23; 24–29; 30–35; 36–41 and over 42 years of age). Most of the research participants were between 18 and 23 years of age (n = 93), this group was followed by those between 24 and 29 years of age (n = 27). The majority of respondents (n = 48) revealed that they have been using m-learning technologies between 2 to 3 years. Table 3 describes the profile of the research participants.

| Gender | n  | %  | Age   | n  | %  | Experience                   | n  | %  |
|--------|----|----|-------|----|----|------------------------------|----|----|
| Female | 75 | 54 | 18–23 | 93 | 67 | Less than a year             | 33 | 24 |
| Male   | 63 | 46 | 24–29 | 27 | 20 | Between 1 and 2 years        | 27 | 19 |
|        |    |    | 30–35 | 9  | 7  | Between 2 and 3 years        | 48 | 35 |
| Total: | 138| 100|       |    |    |                              | 30 | 22 |
|        |    |    |       |    |    | More than 4 years            | 0  | 0  |
| Total: | 138| 100|       |    |    |                              |    |    |
5.2 The descriptive statistics

Generally, the respondents indicated that they agreed with the questionnaire’s statements as there were high mean (M) scores that were above the midpoint (3). There was only one value (that represented a behavioral intention item – INT3) that was slightly below 3 (M = 2.93). Moreover, the standard deviation values (SD) indicated that there were small variances in the participants’ responses. These values varied from 0.743 to 1.31. Overall, there was a normal distribution in the dataset except for PEoU1, PEoU2, PEoU3 and FC2.

5.3 The principal component analysis

The Kaiser Meyer Olkin test reported a KMO of 0.654. Therefore, the sampling adequacy was acceptable as it was well above 0.5 (Field, 2005). Bartlett’s test of sphericity revealed that there was sufficient correlation in the dataset to run a principal component analysis (PCA) since $p < 0.001$. Therefore, a PCA assessed the validity of the constructs and provided a factor solution of salient components that shared relevant similarities (and differences) (Ngai et al., 2007).

A varimax rotation was used to reconstruct this study’s seven composite factors. The items with the highest loadings were used to identify the factor components. The values of the factor loadings were more than 0.5. Hence, they indicated that there were highly significant correlations among the factors in our research model. Table 4 illustrates the findings from PCA. It features the extracted components, their respective eigenvalues, percentages of variance, cumulative percentages of variances as well as the values that represented Cronbach’s alpha for every construct.

The factors components accounted for 76% of the variance. Cronbach’s alpha values were higher than 0.7 for all constructs (this finding is consistent with the recom-

| Component                      | Initial Eigenvalues | Rotation Sum of Square Loadings | Cronbach’s Alpha |
|--------------------------------|----------------------|---------------------------------|------------------|
|                                | Eig.                 | % of Var. | Cum. % | Eig. | % of Var. | Cum. % |                 |
| 1 Perceived ease of use (PEoU) | 4.800                | 25.468   | 25.468 | 3.226 | 17.117   | 17.117 | 0.92            |
| 2 Intentions (INT)             | 2.526                | 13.399   | 38.868 | 2.190 | 11.620   | 28.737 | 0.89            |
| 3 Social influences (SI)       | 2.202                | 11.681   | 50.549 | 1.852 | 9.823    | 38.560 | 0.86            |
| 4 Perceived usefulness (PU)    | 1.597                | 8.471    | 59.020 | 2.000 | 10.611   | 49.171 | 0.85            |
| 5 Facilitating conditions (FC) | 1.305                | 6.921    | 65.941 | 2.386 | 12.658   | 61.828 | 0.82            |
| 6 Attitude (ATT)               | 0.994                | 5.276    | 71.216 | 1.639 | 8.697    | 70.526 | 0.79            |
| 7 Engagement (ENG)             | 0.922                | 4.892    | 76.109 | 1.052 | 5.583    | 76.109 | 0.76            |
mended threshold). The alpha coefficient ranged from 0.76 (for ENG) to 0.92 (for PEOu).

5.4 The results from the regression analysis

A stepwise procedure was used to investigate whether there were significant correlations. The $p$-value had to be less than 0.05 benchmark. Therefore, the insignificant variables were excluded from this empirical investigation.

The first five hypotheses were related to the TAM (‘attitudes’ construct is also used in TPB), and the latter three hypotheses were associated with UTAUT. The following results represent the strength and the significance of the hypothesized relationships.

H1: The results from the linear regression analysis revealed that the students’ intentions to use m-learning technologies anticipated their usage, where the $r^2 = 0.418$ and the $t$ value = 2.235. This relationship was significant, as $p = 0.026$. H2: There was also a positive and significant relationship between the students’ perceived ease of use of m-learning technologies and their perceived usefulness, where the $r^2 = 0.303$ and the $t$ value = 1.904. This relationship was significant, as $p = 0.043$.

H3: The students’ perceptions on the ease of use of m-learning technologies had a positive and very significant effect ($p < 0.001$) on their attitudes towards their utilization, where the $r^2 = 0.157$ and the $t$ value = 4.877. H4: Similarly, the students’ perceptions on the usefulness of m-learning technologies had a positive and highly significant effect ($p < 0.001$) on their attitudes, where adj. $r^2 = 0.163$ and $t = 3.984$. H5: There was also a positive and significant relationship between the students’ attitudes toward m-learning technologies and their behavioral intentions to use them, as adj. $r^2 = 0.111$ and $t$ value = 5.136. The measurement of significance indicated a confidence level of 97% (where $p = 0.03$).

H6: The research participants’ social influences (from their course instructor or from their peers) did not have a significant effect on their intentions to use m-learning technologies. In this case the results were inconclusive as $p > 0.05$. H7: Similarly, there was no correlation between facilitating conditions and the students’ intentions to use m-learning technologies, as $p > 0.05$. H8: Nevertheless, the university’s facilitating conditions had a significant effect ($p = 0.02$) on the students’ engagement with m-learning technologies, where adj. $r^2 = 0.435$ and $t$ value = 13.608.

6 Conclusions

6.1 Theoretical implications

This contribution has presented a critical review of the relevant literature that was focused on the use of m-learning. It reported that the university students were using mobile technologies to improve their learning outcomes. In the past years, a number of academic authors contended that educational apps were supporting many students in different contexts Butler et al., 2021; Crompton & Burke, 2018; Hamidi & Chavoshi, 2018; Sung et al., 2016; Tosuntas et al., 2015). In the main, they maintained that ubiquitous technologies enable them
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One may argue that the m-learning paradigm is associated with the constructivist approaches (Chang et al., 2018), including those related with discovery-based learning (Camilleri & Camilleri, 2019c). Relevant theoretical underpinnings suggest that the use of mobile apps can improve the delivery of quality, student-centered education (Camilleri & Camilleri, 2021; Camilleri, 2021b; Chang et al., 2018; Crompton & Burke, 2018; Furió et al., 2015; Lameu, 2020; Nikolopoulou et al., 2021; Sung et al., 2016; Swanson, 2020). This research raises awareness on m-learning technologies that enable students to search for solutions for themselves through the Internet and via learning management systems. It also indicated that mobile apps like Microsoft Teams or Zoom, among others, allow them to engage in synchronous conversations with course instructors and with their peers, in real time.

This study explored the users’ perceptions about m-learning technologies. It validated key constructs from TAM Briz-Ponce et al., 2017; Cheung & Vogel, 2013; Granić & Marangunić, 2019; Ngai et al., 2007; Scherer et al., 2019; Thong Hong & Tam, 2002) and UTAUT (Gunasinghe et al., 2019; Yang et al., 2019).

The descriptive statistics clearly indicated that the research participants felt that m-learning technologies were useful for them to continue their course programs. The principal component analysis confirmed that the students’ engagement with their educational apps was primarily determined by their ease of use. This is one of the main factors that influenced their intentions to engage with m-learning apps.

The findings revealed that higher education students were using m-learning apps as they considered them as useful tools to enhance their knowledge. Evidently, their perceptions about the ease of use of m-learning technologies were significantly correlated with their perceived usefulness. In addition, it transpired that both constructs were also affecting their attitudes towards usage, that in turn preceded their intentions to use m-learning apps.

The results also revealed that the respondents were satisfied by the technical support they received during COVID-19. Apparently, their university provided appropriate facilitating conditions that allowed them to engage with m-learning programs during the unexpected pandemic situation and even when the preventative restrictions were eased.

The stepwise regression analyses shed light on the positive and significant relationships of this study’s research model. Again, these results have proved that the respondents were utilizing m-learning apps because their university (and course instructors) supported them with adequate and sufficient resources (i.e. facilitating conditions). The findings indicated that they were assisted (by their institution’s helpdesk) during their transition to emergency remote learning. In fact, the study confirmed that there was a positive and significant relationship between facilitating conditions and the students’ engagement with m-learning technologies.

On the other hand, this empirical research did not yield a statistically significant relationship between the students’ social influences and their intentions to use the mobile technologies. This is in stark contrast with the findings from past contributions, where other researchers noted that students were pressurized by course instructors to use education technologies (Camilleri & Camilleri, 2020; Teo & Zheng, 2014). The researchers presume that in this case, the majority of university students indicated that they were not coerced by educators or by their peers, to use m-learning apps. This finding implies that students
became accustomed or habituated with the use of mobile technologies to continue their course programs.

This research builds on previous technology adoption models Davis et al., 1989; Venkatesh et al., 2003; 2012) to better understand the students’ dispositions to engage with m-learning apps. It integrated constructs from TAM with others that were drawn from UTAUT/UTAUT2. To the best of the researchers’ knowledge, currently, there are no studies that integrated facilitating conditions and social influences (from UTAUT/UTAUT2) with TAM’s perceived ease of use, perceived usefulness and attitudes. This contribution addresses this knowledge gap in academia. In sum, it raises awareness on the importance of providing appropriate facilitating conditions to students (and educators). This way, they will be in a better position to use educational technologies to improve their learning outcomes.

6.2 Practical implications

This research indicated that students held positive attitudes and perceptions on the use of m-learning technologies in higher educational settings. Their applications allow them to access course material (through Moodle or other virtual learning environments) and to avail themselves from video conferencing facilities from everywhere, and at any time. The respondents themselves considered the mobile technologies as useful tools that helped them improve their learning journeys, even during times when COVID-19’s preventative measures were eased. Hence, there is scope for university educators and policy makers to create and adopt m-learning approaches in addition to traditional teaching methodologies, to deliver quality education (Camilleri, 2021).

Arguably, m-learning would require high-quality wireless networks with reliable connections. Course instructors have to consider that their students are accessing their asynchronous resources as well as their synchronous apps (like Zoom or Microsoft Teams) on campus or in other contexts. Students using m-learning technologies should have appropriate facilitating conditions in place, including adequate Wi-Fi speeds (that enable access to high-res images, and/or interactive media, including videos, live streaming, etc.). Furthermore, higher education institutions ought to provide ongoing technical support to students and to their members of staff (Camilleri & Camilleri, 2021).

This study has clearly shown that the provision of technical support, as well as the utilization of user-friendly, m-learning apps, among other factors, would probably improve the students’ willingness to engage with these remote technologies. Thus, course instructors are encouraged to create attractive and functional online environments in formats that are suitable for the screens of mobile devices (like tablets and smartphones). There can be instances where university instructors may require technical training and professional development to learn how to prepare and share customized m-learning resources for their students.

Educators should design appealing content that includes a good selection of images and videos to entice their students’ curiosity and to stimulate their critical thinking. Their educational resources should be as clear and focused as possible, with links to reliable academic sources. Moreover, these apps could be developed in such a way to increase the users’ engagement with each other and with their instructors, in real time.

Finally, educational institutions ought to regularly evaluate their students’ attitudes and perceptions toward their m-learning experiences, via quantitative and qualitative research, in order to identify any areas of improvement.
6.3 Research limitations and future research directions

To date, there have been limited studies that explored the institutions’ facilitating conditions and utilitarian motivations to use m-learning technologies in higher education, albeit a few exceptions. A through review of the relevant research revealed that researchers on education technology have often relied on different research designs and methodologies to capture and analyze their primary data. In this case, this study integrated measures that were drawn from TAM and UTAUT. The hypotheses were tested through stepwise regression analyses. The number of respondents that participated in this study was adequate and sufficient for the statistical purposes of this research.

Future research could investigate other factors that are affecting the students’ engagement with m-learning technologies. For example, researchers can explore the students’ intrinsic and extrinsic motivations to use educational apps. These factors can also have a significant effect on their intentions to continue their learning journeys. Qualitative research could shed more light on the students’ in-depth opinions, beliefs and personal experiences on the usefulness and the ease of use of learning via mobile apps, including serious games and simulations. Inductive studies may evaluate the effectiveness as well as the motivational appeal of gameplay. They can possibly clarify how, where and when mobile apps can be utilized as teaching resources in different disciplines. They can also identify the strengths and weaknesses of integrating them in the curricula of specific subjects.

Prospective researchers can focus on the design, structure and content of m-learning apps that are intended to facilitate the students’ learning experiences. Furthermore, longitudinal studies may provide a better understanding of the students’ motivations to engage with such educational technologies. They can measure their progress and development, in the long term. The students’ perceptions, attitudes and intentions to use m-learning technologies can change over time, particularly as they become experienced users.

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