

# Factors that Influence the Acceptance and Adoption of Mobile Learning Applications in Higher Education: A Systematic Review

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## Abstract

Research showed that the number of students that use their mobile devices and apps for learning purposes doubled between 2012 and 2016. This growth enables new forms of learning to be used in higher education settings, like mobile learning. To make sure mobile learning can be successful in higher education, it is necessary to understand what the factors are that influence the acceptance and adoption of mobile learning apps in higher education. Different studies mention different factors. This systematic review lists the most emerging ones of the last decade like Self-Efficacy and Perceived Enjoyment by looking at the influences on both students and teachers. This study also proposes an extended version of the Unified Theory of Acceptance and Use of Technology (UTAUT) model, called the Acceptance and Adoption of Mobile Learning Applications (AAMLA) model, using these found factors. Based on the research model, twenty hypotheses were defined for other studies to be able to validate and use the model. This model could provide app developers, higher education institutes and other researchers useful insights to explain the acceptance and adoption of mobile learning apps in higher education.

## 1 Introduction

In a study done by the University of Central Florida, it appeared that the number of students that use their mobile devices and apps for learning purposes doubled over the years between 2012 and 2016 (Seilhamer et al., 2018). This growth enables new forms of learning to be used in higher education (HE) settings, like mobile learning (m-learning). The use of m-learning in HE has grown dramatically over the past few years, as more and more international universities started using it (Alowayr and Al-Azawei, 2021). To gain a better understanding of how to successfully use m-learning in higher education settings, it is necessary to know what the factors are that influence the acceptance of mobile learning among students and teachers (Alghazi et al., 2021). The purpose of this study is to provide the mobile learning app

developers, higher education institutes and researchers with an overview of the factors that influence the acceptance and adoption of mobile learning apps in HE and a proposal for an extension of the UTAUT model in the context of digitalization and HE mobile learning.

### 1.1 Background

Mobile learning can be defined as “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” (Mehdipour and Zerehkafi, 2013). For higher education, it means that the students, as well as the teachers, can access the lectures and other educational material at any time and anywhere using mobile devices. These mobile devices are small, portable devices that can be handheld and easily travelled with, like smartphones, tablets and Personal Digital Assistants (PDA's) (Alharbi and Drew, 2014). To use them, different mobile learning applications have been developed like Mobile Learning Management Systems (MLMS) or web-based applications that run on these mobile devices. Therefore, any type of app that is used for learning purposes is considered a mobile learning app and can be used for mobile learning.

Many universities have started going online in the past few years and the context of higher education shifted to distance learning (Ali, 2020). Mobile learning makes this distance learning easier since learning can now happen anywhere using the mobile devices instead of needing a connected PC. Even though the ease of mobile learning was beneficial for the education shift to distance learning, studies have shown that it is also beneficial for the students to be able to access the learning contents online everywhere since it makes the education process more acceptable to students (Alghazi et al., 2021). The age of digitalization makes it so that almost all students have access to mobile phones (Ali, 2020) and can therefore prepare lectures, make assignments and submit work anytime they want, which makes m-learning such a commonly used form of learning nowadays. The successful implementation of m-learning however, cannot be explained only by looking at these benefits. Some larger, more in-depth models are needed to assess the acceptance.

There are a few models that can determine the critical factors that influence the acceptance of mobile learning

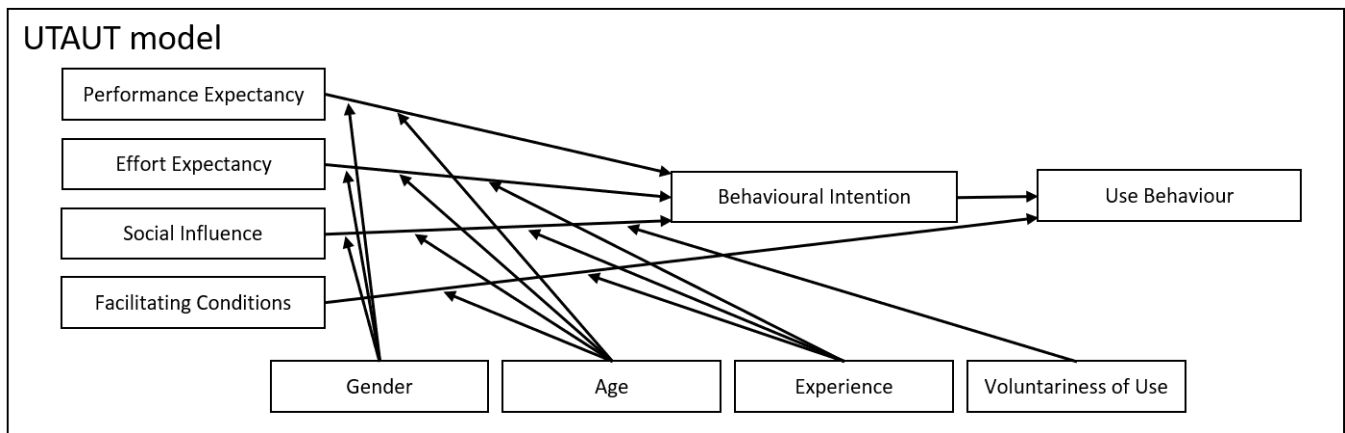


Figure 1: UTAUT model by Venkatesh (2003)

apps such as the Technology Acceptance Model (TAM), the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and others. The most popular one however is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as shown in Figure 1, which is proved to be a valid and robust model (Almaiah et al., 2019). The model, which is an extension of TAM (Shroff and Keyes, 2017), investigates how four constructs, being Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC), affect the acceptance and usage of technology (Venkatesh, 2003). The first construct, Performance Expectancy, is “the degree to which an individual believes that using the system will help him or her to attain gains in job performance”. Effort Expectancy is “the degree of ease associated with the use of the system”. The third one, Social Influence, is “the degree to which an individual perceives that important others believe he or she should use the new system”. Facilitating Conditions, the last one, is “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system”. Next to these four constructs, four variables are defined to moderate the influence of the four constructs on the acceptance, which are Gender, Age, Experience and Voluntariness of Use. Together, these eight factors form the UTAUT model, which can explain 70% of the acceptance of technology (Masrek and Samadi, 2017). This indicates, however, that there is still an unexplained part of technology acceptance, which is why different studies propose extensions for the model.

Recent studies done on the acceptance of mobile learning investigated for example the self-determination and expectation-confirmation theories together with the UTAUT model (Aloyayr and Al-Azawei, 2021). Other research was done regarding the influence of some technical factors on the usage of mobile learning (Alghazi et al., 2021). This study also used an extended version of the UTAUT model to examine the effects of those factors on the intention to use mobile learning. Both studies indicate that they found new factors that have an impact on the acceptance of mobile learning in higher education. For example, perceived autonomy (PA), which is whether the user has the feeling

that they can freely decide how to use the system (Aloyayr and Al-Azawei, 2021). Some other examples are network speed and device performance, which both have a strong influence on the acceptance of m-learning (Alghazi et al., 2021). Both studies however, stated that the acceptance of m-learning is still not fully known and that their extensions of the UTAUT model do not fully describe the variance of the behavioural intention. This study will therefore focus on making an overview of the main factors that have been found over the years influencing students’ and teachers’ acceptance of mobile learning. This research will also try to fit these factors into the UTAUT model to fully describe the variance in the behavioural intention to use m-learning.

This study will focus on answering the following research question: “*The unified theory of acceptance and use of technology (UTAUT) model is commonly used to explain factors that influence technology acceptance: investigate what are the factors that influence acceptance and adoption of mobile (learning) apps in higher education (HE) in the age of digitalization?*”. The question is divided into two sub-questions:

1. What are the factors that influence the acceptance and adoption of mobile learning apps in higher education?
2. How can the UTAUT model be extended to explain emerging factors that affect the adoption and acceptance of HE mobile learning apps in the context of digitalization?

## 2 Methodology

This study is a systematic review in which existing papers have been investigated and interpreted with the goal to find factors to extend the UTAUT model and answer the two sub-questions. In a systematic review the researcher selects, identifies and synthesizes primary research to create an overview of the reviewed subject (Crompton and Burke, 2018).

Inclusion criteria	Exclusion criteria
The research setting is in higher education The research must investigate factors that are not already in UTAUT The research must include empirical evidence The research must be original research The research must be peer reviewed	The research article should not be in a language other than English The research must not be about the readiness of students

Table 1: Inclusion and exclusion criteria

## 2.1 Search strategy

Following the PRISMA<sup>1</sup> principles, the research began with digital searches for the literature. This study investigated papers from IEEE Xplore Digital Library, Scopus and Web of Science since these databases are recommended for Computer Science research by TU Delft<sup>2</sup>. The search terms included ‘mobile learning’, ‘acceptance’, ‘adoption’, ‘usage’ and ‘higher education’ since these are the core constructs of the research question. They therefore gave the most relevant results for this research. The search terms ‘apps’ and ‘applications’ have not been used, since they excluded some relevant results from the other keywords and therefore limited the search. Also, since mobile learning is done through the use of apps, searching for factors influencing m-learning, resulted in factors influencing m-learning apps as well. This broader search resulted in a more complete overview.

## 2.2 Study selection

Because the research is focused on the age of digitalization, the search was limited to the years from 2010 until present day. From the year 2010, the student-teacher ratios were getting larger and the need for a new system in which ubiquitous learning is used was high (Dede, 2011). Also Apple’s iPad and Samsung’s Galaxy S, two frequently used mobile devices, were released in 2010. On top of that, the sales of e-readers rose tremendously (Statista, 2013) which marks 2010 as a good starting point for the research on mobile learning and the acceptance and adoption of mobile learning in higher education. The initial search resulted in 338 papers.

## 2.3 Inclusion/exclusion criteria

From the initial search, six papers were removed because they were not in English. Then another 39 were discarded since they were duplicates. The remaining 293 were checked on the title, abstract and keywords with the inclusion and exclusion criteria, which are shown in Table 1. This selection removed 247 papers that, for example, were not in a higher education setting. There were also some papers that only studied the UTAUT model without looking at new emerging factors. Those were not relevant for this study and were also excluded. This left 46 articles to be studied for factors that influence acceptance and adoption of mobile learning.

<sup>1</sup>[www.prisma-statement.org](http://www.prisma-statement.org)

<sup>2</sup><https://databases.tudl.tudelft.nl/?f=EEMCS&d=CS&t=&q=&y0=research%20data&y1=reference&y2=articles&y3=reports&y4=standards&y5=e-books&y6=e-journals&y7=patent%20information&y8=statistics&y9=educational%20resource&y10=theses&y11=&y12=catalogue>

## 2.4 Analysis framework

Based on the research question, two elements were chosen to be analysed. First, research outcome, which gives the significant acceptance factors, and second, research target group, which gives the people that these factors influence. Using these two elements, the overview of the emerging factors influencing the acceptance and adoption of m-learning in higher education can be given.

## 2.5 Coding

In this research the two research elements have been coded together. In the coding of the research outcome, a separation is made by looking at the target group. The outcomes were then inductively coded according to a paper from Chavoshi and Hamidi (2019). The factors that have been found during the research have been coded into five categories: individual factors, pedagogical factors, social factors, technological factors and teacher specific factors. Individual factors refer to personal characteristics, pedagogical factors have to do with the teaching and learning experience, the social factors are influences from other people, the technological factors are the ones regarding technical parts and support and the teacher specific factors are factors that have only been found significant for teachers and not for students. According to Chavoshi and Hamidi, the factors that influence the acceptance and adoption of mobile devices as an educational strategy can be divided into these first four categories. Since teachers play a different role in education than students, their factors have been listed separately.

## 3 Results and discussion

### 3.1 Overview of the factors that influence the acceptance and adoption of mobile learning apps in higher education

Four student categories, individual factors, pedagogical factors, social factors and technological factors have been used to sort the findings of the literature review. In the next four sections, each of the categories is explained and the factors they contain are discussed. Most of the studies were about students, but there are also some findings of factors affecting teachers which are mentioned separately in the last section. Both direct and indirect factors that impact the acceptance and adoption of m-learning are discussed. The overview of the findings can be found in Table 2.

#### 3.1.1 Factors that influence HE students’ acceptance and adoption of m-learning apps

Students have the role of learners in mobile learning in the context of higher education. They are the ones who use the

<b>Individual factors</b>
Self-Efficacy (SE)
Personal Innovativeness (PI)
<b>Pedagogical factors</b>
Information Quality (IQ)
Perceived Enjoyment (PEN)
Perceived Choice (PC)
<b>Social factors</b>
Instructor Readiness (IR)
University Management Readiness (UMR)
<b>Technological factors</b>
Technical Factors (TF)
Perceived Security (PS)
Perceived Compatibility (PCOM)
<b>Teacher specific factors</b>
Social Culture (SC)
Age
Training

Table 2: Overview of the factors found in the literature review

m-learning apps to extend their knowledge. This is why it is important that the acceptance of students is studied, starting with the individual factors.

### Individual factors

Individual factors are the factors that depend on individual characteristics (Chavoshi and Hamidi, 2019). These are the personal factors that are not easily adjustable by mobile learning app developers or other people, which means that for some people m-learning will never be an option regardless of the quality or importance. The individual factors are important to look at to understand which personal characteristics play a significant role in the acceptance of m-learning.

The first significant individual factor is Self-Efficacy (SE). SE is the ability to perform certain tasks (Gómez-Ramírez et al., 2019), which in this case is focused on the ability to use m-learning apps. Gómez-Ramírez et al. state that perceived SE has a positive impact on the acceptance of m-learning. This finding is in line with Adedaja et al. (2013), Kumar et al. (2020) and others. Kumar et al. even state that mobile learning SE has, compared to other external factors, the most decisive influence. For that reason, students' m-learning skills should be continuously improved. A factor that was studied multiple times and is very similar to SE is Self-Management of learning (SM). SM is whether a person feels capable of learning autonomously (Aofan et al., 2016), which is one of the main constructs of mobile learning. Aofan et al. claim however, that SM has no significant influence on the intention to use m-learning, while Al-Adwan et al. (2018) show that SM has a negative correlation with the intention to use m-learning. They say that students with lower Self-Management will expect a lower value of m-learning system functionality and performance and will therefore be less likely to use it.

The second main individual factor that showed a significant impact on m-learning acceptance is Personal Innovativeness (PI). According to Paturusi et al. (2015) PI is a person's

willingness to try something new, which in the context of mobile learning is the eagerness to adopt mobile learning. PI has shown to be significant to influence the intention to use m-learning (Sidik and Syafar, 2020). This means that students with more innovativeness and personal knowledge are more willing to use mobile learning. Supporting this outcome, Shorfuzzaman and Alhussein (2016) explain that learners' creativity, which is in the literature also seen as PI, influences the intention to use mobile learning. Adedaja et al. (2013) showed that Interest, which is closely related to Personal Innovativeness, has also a very significant impact on the acceptance of m-learning. They even showed that interest has a more significant influence on mobile learning than Self-Efficacy, which indicates how different the acceptance of such technologies can be between different individuals with different interests.

It is unclear if gender influences the acceptance of m-learning. Multiple researchers studied the significance of gender to the adoption of mobile learning, but the results were contradicting. Pramana (2018) for example, states that gender only has a moderating effect on the correlation between Learning Autonomy and the intention to use m-learning and that this moderation only holds for male students. According to him, gender has no further influences on the acceptance of mobile learning. Al-Emran et al. (2019) on the other hand, show a significant difference in the attitude towards mobile learning between male and female, where male students have a higher attitude towards m-learning. Since attitude influences the intention to use mobile learning according to the TAM model, it would indicate that gender does influence the acceptance of mobile learning in higher education. This is supported by research done by Nawaz and Mohamed (2020), who showed that gender moderates the relations of different factors and the intention to use mobile learning. They also claim that age is a moderating variable and that therefore age differences influence the acceptance of m-learning. In general, research on factors influencing mobile learning acceptance for students does not include age since the age differences for the target group is not significant. The study of Nawaz and Mohamed used clusters of younger than 20 years old, between 21 and 30 and older than 30, which only shows that very young or old students may have a different level of acceptance than students between 21 and 30 years old. But since most of the students are in that range, age is not a significant factor for students' acceptance, or at least it has not been researched enough.

### Pedagogical factors

Pedagogical factors are the factors that have something to do with the teaching or learning itself (Chavoshi and Hamidi, 2019). These factors can be influenced by app developers since they are related to the contents and abilities of their mobile learning apps. They influence the things learners can do with them and the way the content is presented. These pedagogical factors are important to make mobile learning apps as attractive as possible.

A significant pedagogical factor that is mentioned more than once is Information Quality (IQ). IQ refers to the output of the system, which includes completeness,

format, information presentation, accuracy of information and correctness of information (Alharbi and Drew, 2014). Alharbi and Drew explain that IQ indirectly influences the intention to use mobile learning in higher education. It has a significant influence on both mobile learning satisfaction and information satisfaction. Another study claims that IQ has an influence on Performance Expectancy and Effort Expectancy (Alshurideh et al., 2019) and Gharaibeh and Gharaibeh (2020) even state that Information Quality also has a direct impact on the intention to use m-learning.

Another pedagogical factor that is significant for the acceptance of mobile learning in higher education is Perceived Enjoyment (PEN). According to Sanjebad et al. (2020) it is whether the technology usage will be expected to be enjoyable apart from possible performance enhancements. Sanjebad et al. describe a strong relation between PEN and the intention to use m-learning. It shows that next to being useful, mobile learning must also be fun to do to be attractive for students in higher education. Pappas et al. (2017) go even further than that and say that if a mobile learning application is not enjoyable, male students will not use it regardless of the other factors influencing mobile learning acceptance. Perceived Playfulness (PP) is often used to indicate if an app is enjoyable, as PP provides intrinsic motivation (Masrek and Samadi, 2017). Masrek and Samadi as well as Karimi (2016) show that Perceived Playfulness has a significant influence on the intention to use m-learning.

The third significant pedagogical factor is Perceived Choice (PC). PC is the degree of freedom and control while using an m-learning application (Shroff and Keyes, 2017). They explain that there are two types of app formats: linear and branching. With the linear format, the learner can only progress in the material after finishing a previous part. The branching format however, allows the learner to choose what part will be done now and what later. Shroff and Keyes show that PC has a significant effect on the intention to use mobile learning and it leads to improved performance. It is therefore important to give the learner control of the application and the content to increase the adoption and quality of the m-learning app.

### **Social factors**

Social factors are influences of others on an individual. As people who use mobile learning are also communicating with others, they are social actors (Chavoshi and Hamidi, 2019). Individuals can be influenced by people who are close to them, like relatives and friends, but also by people who have a more indirect relation. Students are more willing to adopt m-learning when influenced by educators, providers and colleagues (Al-Adwan et al., 2018). Because of that, it is important to keep the social factors in mind, although it is harder for m-learning app developers and researchers to influence these factors.

Instructor Readiness (IR) is one of the significant social factors that influence the acceptance of m-learning for students. The two most important social groups influencing students norms are other students and teachers (Gómez-Ramírez et al., 2019). So for students to accept mobile learning, they must have perceived a high readiness of their

teacher. Gómez-Ramírez et al. state that the relation between IR and the intention to use m-learning is indirect and weaker than other factors, however, it is still significant. This is in line with the findings of Azizi and Khatony (2019) who say that IR is very important to the successful adoption of m-learning. Alharbi and Drew (2014) show that, in line with the previously mentioned studies, lecturers' attitude mildly influences the intention to use mobile learning. They indicate however, that this relation is direct, which implies that the importance of the teachers in the acceptance of m-learning for students is significant. Last, the influence and motivation of the teacher to use m-learning helps the student to adopt the technology faster and easier (Abu-Al-Aish and Love, 2013).

Next to students and teachers, a third party has a large influence on the success of mobile learning in higher education (Alrasheedi et al., 2015). Their study explains the factors that influence the acceptance of m-learning for university management. The management, consisting of heads of departments, deans and information technology system administrators, must be willing to adopt mobile learning before students can engage with it. Therefore the second significant social factor for students' acceptance of mobile learning is University Management Readiness (UMR). Alrasheedi et al. describe three significant factors for the UMR, being university commitment towards m-learning, university organizational learning practices and university change management practices. The first one, the commitment towards m-learning, is whether the university is adopting m-learning in their strategic vision and whether the employees feel committed to the university. The university learning practices factor is regarding the training of the employees and improving as a whole by learning from their mistakes and comments from others. The last one, the change management practices, is about the way the university adapts to changes and the willingness to switch to a new learning platform. These three factors were shown to be significant in the adoption of mobile learning in university management, which ultimately decides if students will be using m-learning or not.

### **Technological factors**

Technological factors are the factors that are involved with the mobile devices such as IT infrastructure, software and hardware of the devices (Chavoshi and Hamidi, 2019). These factors have to do with the limitations and advantages of mobile devices and the infrastructure that makes it possible to use them. Although the limitations and advantages of mobile devices immensely differentiate between certain devices, it is important to account for possible shortcomings, but also to make use of possible advantages. Next to that, the infrastructure around m-learning needs to be taken into account to get the best out of the mobile learning system.

The first major group of technological factors are the Technical Factors of mobile devices (TF). The study of Alghazi et al. (2021) showed that TF of mobile devices influence the acceptance of m-learning in higher education significantly. They indicate that network speed, device performance and device compatibility have the strongest influence. Some other factors, network coverage, device memory and device connectivity, were shown to have

a moderate effect on the acceptance of mobile learning. Another technical factor, that is also researched by Moorthy et al. (2019), is price value. Price value is whether the monetary costs weigh off to the functional benefits of m-learning. Both studies claim that price value has a significant influence on the intention to use mobile learning, especially because of the income levels of students.

The second significant technological factor is Perceived Security (PS). PS is the level of data integrity, data privacy and user authorization around the m-learning system (Almaiah et al., 2019). Almaiah et al. explain that the universities need to ensure that these factors are of a sufficient level to use mobile learning securely. Their study also shows that PS significantly influences the intention to use m-learning as well as the trust of students which in itself influences the acceptance of m-learning. Closely related to the security is the perceived risk as described by Chao (2019), who also mentions privacy problems, security software and losing passwords. Chao claims that the perceived risk moderates the relation between performance expectancy and the intention to use m-learning, which shows the importance of security features in mobile learning. Both Almaiah et al. and Chao, as well as, Al-Adwan et al. (2018) indicate that trust has a significant influence on the intention to use mobile learning and that trust shows whether the learner feels secure using the technology. The significance of trust in the acceptance of m-learning in higher education illustrates the importance of a secure mobile learning network created by the universities and a secure m-learning app created by the developers.

Another technological factor is Perceived Compatibility (PCOM). Next to device compatibility (Alghazi et al., 2021), PCOM includes the personal needs and perceptions (Almaiah et al., 2019). In that research Almaiah et al. show that PCOM has a significant influence on the use of mobile learning. In a later study (Almaiah et al., 2020) they even describe that PCOM is significant in all stages of m-learning adoption. The mobile learning app must therefore be compatible with most mobile devices but also with the way of learning of the students to be successful. Important with that is that it fits in the current learning methods and online services being used, which is why it is necessary for m-learning app developers to re-identify the students' needs to successfully integrate the app in higher education (Almaiah et al., 2020).

### **3.1.2 Factors that influence HE teachers' acceptance and adoption of m-learning apps**

Besides student and university management acceptance, teachers also have their own factors that influence the acceptance of mobile learning, which are necessary to take into account for good integration of mobile learning in higher education. Some factors mentioned in the literature are the same as the ones for students. Cost (Eppard et al., 2019), Perceived Enjoyment (Eppard et al., 2019), Self-Efficacy (Hur et al., 2015) and Personal Innovativeness (Alfarani, 2014), or constructivist beliefs which indicates whether the teachers prefer traditional or active learning (Hur et al., 2015), are all factors that influence students as well as teachers. However, some factors are only studied in relation to teachers,

which makes them important to consider when developing a mobile learning app.

### **Teacher specific factors**

One of the teacher specific factors is Social Culture (SC), which is the culture within an organization. Different countries can have different cultures and different subjective norms that change the way technology is adopted and used (Alfarani, 2014). In her study, she shows that individuals of the Saudi culture have a lower intention to use m-learning, which indicates the significance of SC on the acceptance of mobile learning. Eppard et al. (2019) are in line with these findings as their study describes that teachers find it essential that the m-learning apps adhere to the cultural norms of the students. They also state that the language level of the app must not be too high, otherwise students cannot understand what is asked of them.

In comparison to students, the age of teachers does have a significant influence on the acceptance of mobile learning. As older teachers have more resistance to change (Alfarani, 2014), they are less likely to accept new technologies and use them in education. Older teachers do not have the same performance expectation level as younger teachers (Al-Hunaiyyan et al., 2017), which also shows that they are less likely to adopt m-learning.

The teachers in the research of Eppard et al. (2019) explain that training is a factor that they think is important to successfully adopt m-learning as it is necessary for the teachers to get familiar with the apps and they should be able to self-evaluate before they train the students with it.

## **3.2 An extension of the UTAUT model in the context of digitalization**

Chapter 3.1 showed that the significant factors that influence the acceptance and adoption of m-learning in higher education can be sorted into five categories. It gave an overview of the factors and explained what they meant and where they came from. However, to be able to use them in research or app development, they need to be integrated into a model to see their direct and indirect relations to the acceptance of m-learning. The UTAUT model has been taken as a base to extend upon and the resulting research model can be found in Figure 2. It is named the Acceptance and Adoption of Mobile Learning Applications (AAMLA) model. The model is focused on the students' acceptance, but the teachers' acceptance is included by adding some relations with Instructor Readiness. The following sections will describe the relations among the factors and give the hypotheses that can be used to validate the model.

### **UTAUT model constructs adjustment**

In the proposed extended UTAUT model the four constructs of the UTAUT model are still present. This is because many recent studies have shown the significance of these factors like Al-Adwan et al. (2018), Nawaz and Mohamed (2020) and Masrek and Samadi (2017). Social Influence (SI) is a bit more debatable as, for example, Alghazi et al. (2021) claims that SI is not significant for the acceptance of mobile learning in higher education. It is therefore divided into two parts being Peer Student Readiness and Instructor Readiness as

used by Gómez-Ramírez et al. (2019) and Azizi and Khatony (2019), since students and instructors are the most important groups influencing students in higher education. This led to the following hypotheses:

*H1: Performance Expectancy has a significant influence on the Behavioural Intention to Use mobile learning*

*H2: Effort Expectancy has a significant influence on the Behavioural Intention to Use mobile learning*

*H3: Peer Student Readiness has a significant influence on the Behavioural Intention to Use mobile learning*

*H4: Instructor Readiness has a significant influence on the Behavioural Intention to Use mobile learning*

*H5: Facilitating Conditions has a significant influence on the Actual Use of mobile learning*

The four moderators of the UTAUT model have been removed in the proposed research model. As discussed in the individual factors section, Gender is not clearly shown to be significant in influencing the acceptance of m-learning or moderating the influences of other factors as some studies claim it is important and others claim it is not. Because of this uncertainty, the Gender variable has been left out. Age was also discarded as moderator since students' ages do not differ enough to indicate the importance of age for the acceptance of m-learning. It did, however, become a teacher specific factor influencing the Instructor Readiness. Since the number of mobile phone subscriptions is almost six times as big now as it was in 2003 (O'Dea, 2020), the variable of Experience is not as emerging as it was back then. Experience has therefore been left out of the proposed UTAUT extension. Finally, the Voluntariness of Use was also removed, because it is not applicable for the higher education context of mobile learning acceptance. If a university decides to use m-learning, students

will be forced to use it as well. The Voluntariness of Use is therefore not researched in the papers of the literature review of this research and has not been included in the proposed model.

### Addition of external factors

Next to the constructs of the original UTAUT model, the literature review pointed at some emerging factors that also influence the acceptance and adoption of mobile learning in higher education. The first of which being Information Quality, which influences the Performance Expectancy as shown by Alharbi and Drew (2014) and Alshurideh et al. (2019). Hence the following hypothesis:

*H6: Information Quality has a significant influence on Performance Expectancy*

Second, Self-Efficacy was researched by Sanjebad et al. (2020) and Pramana (2018) to have a significant influence on Effort Expectancy, which is therefore included in the proposed research model and gave the following hypothesis:

*H7: Self-Efficacy has a significant influence on Effort Expectancy*

The factors influencing instructor readiness are the ones discussed earlier in the teacher specific factors section, namely Age, Training and Social Culture. This part of the model only partially describes the acceptance of mobile learning for higher education teachers, since Perceived Enjoyment for example also influences teachers (Eppard et al., 2019). But because these three factors are specifically for teachers' acceptance, they are the only ones shown in the model. This gave the following three hypotheses:

*H8: Age has a significant influence on Instructor Readiness*

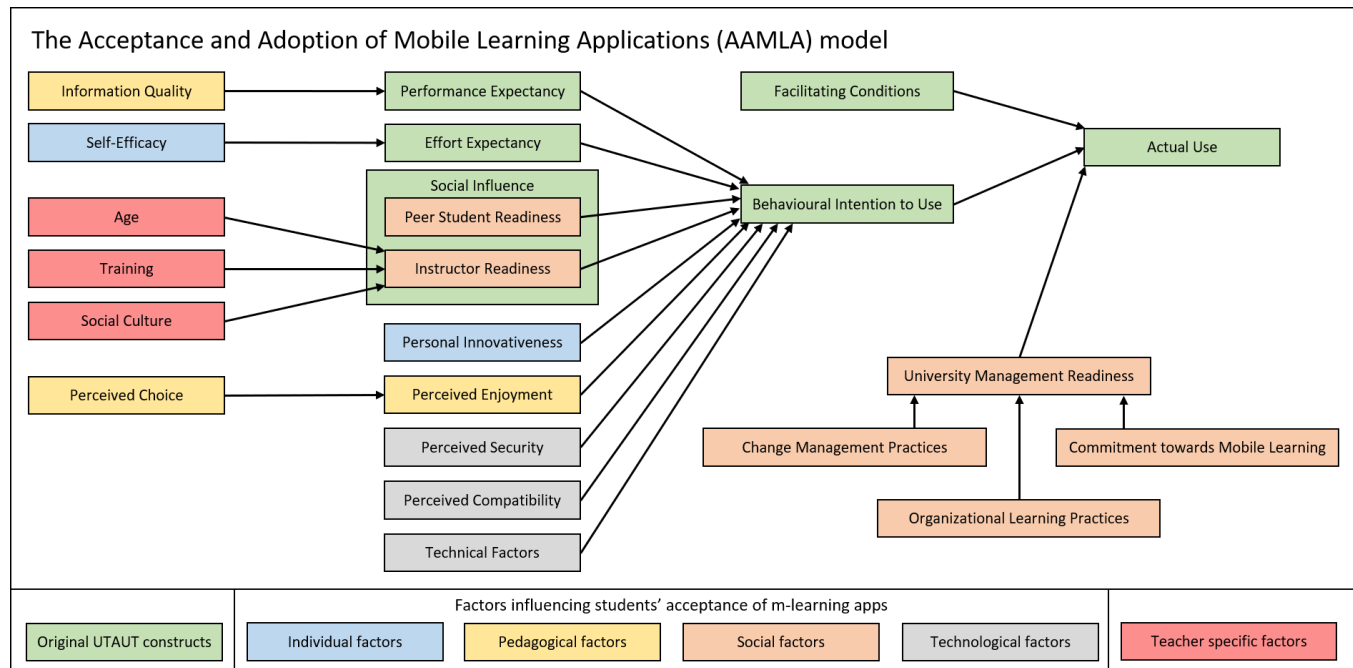


Figure 2: The proposed research model, called the AAMLA model

*H9: Training has a significant influence on Instructor Readiness*

*H10: Social Culture has a significant influence on Instructor Readiness*

The sixth factor is Personal Innovativeness which is shown to have a direct influence on the intention to use m-learning by Abu-Al-Aish and Love (2013), Sidik and Syafar (2020) and Paturusi et al. (2015). It is therefore included in the research model which led to the following hypothesis:

*H11: Personal Innovativeness has a significant influence on the Behavioural Intention to Use mobile learning*

Next to that are Perceived Enjoyment and Perceived Choice. Karimi (2016), Pramana (2018), Sanjebad et al. (2020) and others described that Perceived Enjoyment has a significant influence on the intention to use mobile learning. Perceived Choice also influences the intention to use (Shroff and Keyes, 2017), but since the fact that students feel more positive when given the freedom of choice (Flowerday and Shell, 2015), Perceived Choice is put in direct relation to Perceived Enjoyment in the proposed model, which led to the following hypotheses:

*H12: Perceived Enjoyment has a significant influence on the Behavioural Intention to Use mobile learning*

*H13: Perceived Choice has a significant influence on Perceived Enjoyment*

The ninth factor is Perceived Security, which is a factor that is more of recent studies. As shown in studies of Almaiah et al. (2019), Chao (2019), Gharaibeh and Gharaibeh (2020) and Al-Adwan et al. (2018), security and trust are significant in the acceptance and use of m-learning and are therefore added in the research model:

*H14: Perceived Security has a significant influence on the Behavioural Intention to Use mobile learning*

The tenth external factor that has a significant influence is Perceived Compatibility. The proposed model includes a direct relation between Perceived Compatibility and the intention to use mobile learning as shown in two studies of Almaiah et al. (2019) and (2020). Hence:

*H15: Perceived Compatibility has a significant influence on the Behavioural Intention to Use mobile learning*

Different technical factors also directly influence the intention to use mobile learning as studied by Alghazi et al. (2021), who researched a lot of factors like device memory and network speed, and Moorthy et al. (2019), who supported the price value factor. The significance of the studied relations indicated the importance of technical factors, which is why they are in the research model:

*H16: Technical Factors have a significant influence on the Behavioural Intention to Use mobile learning*

Last, the University Management Readiness and the three factors influencing it as researched by Alrasheedi et al. (2015), are put in the proposed research model as influencing the actual use of m-learning in higher education. Since the university management decides whether to use m-learning in higher education it can either make it or break it for the mobile learning apps and is therefore a deciding factor for the actual use of m-learning. This gave the last four hypotheses:

*H17: University Management Readiness has a significant influence on the Actual Use of mobile learning*

*H18: Change Management Practices has a significant influence on University Management Readiness*

*H19: Organizational Learning Practices has a significant influence on University Management Readiness*

*H20: Commitment towards Mobile Learning has a significant influence on University Management Readiness*

## 4 Responsible Research

This project had no conflict of interest that could have affected the researcher's objectivity. There was also no funding for the research that could have influenced the researcher's objectivity. All the paraphrases have been cited and the sources of the citations used are mentioned, so no plagiarism was committed. Next to that, the UTAUT model in Figure 1, taken from another paper, has the source to it and all credits for that model go to V. Venkatesh. The rest of the figures and tables are own work and therefore no permissions are warranted. All papers used in this literature review are open access and can be checked if needed.

## 5 Limitations

This study searched for papers in IEEE Xplore, Scopus and Web of Science. However, other research that is not available in these databases could explain other emerging factors that were not mentioned in the studied papers. Also, only papers in English have been investigated which limits this research.

## 6 Conclusions

The aim of this study was to answer the main research question and investigate the factors that influence the acceptance and adoption of m-learning apps in higher education. This was done in two parts. First, giving an overview of the factors that influence the acceptance and adoption of m-learning apps in higher education and second, extending the Unified Theory of Acceptance and Use of Technology (UTAUT) model with the emerging factors found in the literature review. A total of 46 papers were used in this review. This research looked at factors influencing both students and teachers by using four student categories, individual, pedagogical, social, technological factors and listing teacher specific factors separately.

The significant individual factors found are Self-Efficacy and Personal Innovativeness. That shows that the acceptance of m-learning partially comes from personal characteristics and that it is therefore hard to influence it. So the acceptance of mobile learning is different per person.

The pedagogical factors that were found to be significant in the review are Information Quality, Perceived Enjoyment and Perceived Choice. These indicate that the quality of the information and the way the information is presented to the learner are important for the acceptance of m-learning. Learners must be able to choose what and when to learn and the process must be enjoyable to increase the acceptance level in higher education.

Two major social factors were found in the review, being Instructor Readiness and University Management Readiness. This shows that the acceptance of mobile learning in higher



education is dependent on all higher educational parties involved. For a successful implementation of m-learning, not only the students and instructors should be ready and willing to use it, but also the university management itself, since they have the final decision on whether m-learning will be used or not.

The significant technological factors that were found in the literature review are Technical Factors, Perceived Security and Perceived Compatibility. This indicates the importance of the mobile devices that are used to which not everybody has access. It also shows that security guarantees like data integrity and data privacy are important for the adoption of mobile learning. Next to that, mobile learning should be compatible with the devices and lifestyles of the users for the highest acceptance.

Last, the literature discussed some factors that are specifically for teachers' acceptance. Contradictory to students, the teacher's age does influence the acceptance of mobile learning as older instructors are less likely to use m-learning. Other factors that were mentioned in the review are Social Culture and Training. This indicates that acceptance levels may vary depending on the culture of the country the teachers live in and that instructors should be well trained before mobile learning can be accepted and used in higher education.

All these factors have been put in an extended UTAUT model, called the Acceptance and Adoption of Mobile Learning Applications (AAMLA) model, based on the relations of the factors with the intention to use m-learning as showed in the literature review. The four constructs of the UTAUT model have been preserved, while the four moderating factors have been removed. The factors that have a direct influence on the intention to use mobile learning are Performance Expectancy, Effort Expectancy, Peer Student Readiness, Instructor Readiness, Personal Innovativeness, Perceived Enjoyment, Perceived Security, Perceived Compatibility and the Technical Factors. The factors indirectly influencing the acceptance are Information Quality which influences Performance Expectancy, Self-Efficacy which influences Effort Expectancy, Age, Training and Social Culture that influence Instructor Readiness and Perceived Choice which influences Perceived Enjoyment. Last, besides the Behavioural Intention to Use influencing the Actual Use, Facilitating Conditions and University Management Readiness also have that relation completing the proposed research model. This model could provide app developers, higher education institutes and other researchers useful insights to explain the acceptance and adoption of mobile learning apps in higher education.

## 7 Implications and future work

Before being able to use the proposed research model, the relations have to be verified by doing an empirical study in a future research. The factors have been shown to be significant on their own, but by putting all of them in one model, the relations can be different in comparison to the previous studies. This is why it is important to verify the model before using it, which was outside the scope of this

research.

Another important note is that the proposed model may be less effective in western countries. Because most of the studies of the literature review are from eastern countries, the factors may not apply as well to higher education in western countries. This could be because of smartphone ownership differences for example. These differences and other possible reasons are something that should be studied in future research to see whether the proposed model can be used all over the world.

This study also showed that there is an uncertainty of the influence of gender on the acceptance of mobile learning in higher education. This therefore needs to be researched in future studies to give a better understanding.

Finally, as time goes on, the factors influencing the acceptance and adoption of mobile learning apps can change due to technological developments. It is therefore important to keep updating the research model with emerging factors that are found in the future to keep the model as significant as possible.

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