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# A comprehensive model explaining teachers' intentions to use mobile-based assessment

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## ABSTRACT

This study was conducted to understand pre-service and in-service teachers' intentions to use mobile-based assessment in classes by integrating theory of planned behaviour, technology acceptance model, and self-determination theory into one conceptual framework. Data were analysed using the structural equation model (SEM). Results of SEM from a sample of 522 pre-service teachers and 279 in-service teachers revealed that, compared to existing theories, the proposed model has a better acceptable level of explanatory power for intention to use mobile-based assessment. Results also showed that all the hypothesis relationship among constructs within the model was supported. In addition, the study identified the prominent mediating role of perceived usefulness, perceived ease of use, and attitude and moderating impact of gender on intention to use mobile-based assessment. All in all, the study provides useful implications for policymakers, teacher educators, and school administrators as well as suggestions for future researchers.

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## KEYWORDS

Pre-service teachers; in-service teachers; mobile-based assessment; theory of planned behaviour; technology acceptance model; self-determination theory

## 1. Introduction

With the increasing the common use of mobile devices, these devices have become powerful learning tools in education (Nikou & Economides, 2017a; Papadakis et al., 2021). It is clear that the use of mobile devices is an important part of education, especially in the era of online learning during and after the Covid-19 epidemic (Muljani & Suwartono, 2022). As a matter of fact, people of this age are familiar with the use of mobile devices and can easily adapt to innovations related to it. With the widespread availability of mobile devices, the younger generation is more tech-savvy and well-accustomed to the use of these devices (Jasim et al., 2021). As a result, they are able to adapt to new innovations in mobile technology with ease (An et al., 2023; Zhang et al., 2023). In education, mobile devices offer numerous benefits such as increased accessibility to educational materials, increased engagement through interactive content, and the ability to facilitate real-time communication and collaboration between students and teachers (Jurayev, 2023; Mohammad et al., 2023; Oliveira et al., 2021; Salhab & Daher, 2023). Additionally, mobile devices can be used for formative assessments, providing teachers with instant feedback on student learning and allowing for more personalized instruction (Hagos & Andargie, 2023; Titova & Talmo, 2014). In conclusion, the use of mobile devices in education is an inevitable trend and plays a crucial role in enhancing the learning experience for students (Burke et al., 2022). Therefore, the use of mobile technology in educational environments has increased (Khan & Gupta, 2022; Nikou & Economides, 2018; Wu et al., 2012) and this situation has offered new opportunities by enabling them to be used in educational assessment (Muljani & Suwartono, 2022; Nikou &

Economides, 2017a). In the literature, it is stated that assessment and mobile technology are among the 15 most discussed topics in the field of educational technology, and this topic is among the most increasing trends in recent years (Chen et al., 2020a, 2020b). Thus, the concept of Mobile-Based Assessment (MBA) has drawn attention. MBA is the evaluation that is carried out through mobile devices (Alfooh & Lakulu, 2021; Bacca-Acosta et al., 2022; Nikou & Economides, 2017b). In other words, the MBA is a comparatively recent form of assessment given by mobile devices (Bacca-Acosta et al., 2022; Muljani & Suwartono, 2022; Nikou & Economides, 2017a). Using the MBA provides significant advantages, as mobile devices are capable of delivering “anywhere” and “anytime” learning content and exams, beyond the boundaries of a traditional classroom (Bacca-Acosta et al., 2022; Nikou & Economides, 2014b; Nikou & Economides, 2018) and they have the potential to evaluate skills at a high level like creativity, collaboration and problem-solving (Nikou & Economides, 2019).

Teachers’ beliefs and attitudes are important for the effective new technology integration into the classroom (Ateş & Garzón, 2022; Sungur-Gül & Ateş, 2021) so that teachers can influence the perceptions of new technology use of students (Nikou & Economides, 2019). Since today’s children are born into technology, they want to have a technology-supported learning experience in learning environments, and more effective learning takes place in such environments (Güntepe & Abdüsselam, 2022). Despite students’ tendency to use technology and their expectations in learning environments, teachers’ resistance to technology use, their inability to integrate technology into their lessons or their avoidance of it due to various difficulties have negative consequences for students. At this point, it is important for teachers to adapt to the use of technology in the classroom in order to meet the expectations and needs of students (Masry-Herzalah & Dor-Haim, 2022). Of course, it is difficult for teachers to adapt to new technologies later. One of the ways to facilitate this process is to ensure that their attitudes towards technology are positive in the pre-service period and to ensure technology adaptation in this process. For these reasons, it is critical that the attitudes of teachers and their adoption of new technologies are formed during the pre-service education period. Instead of encountering technology for the first time as a teacher, accepting new technologies in the pre-service period and beginning their professional life contributes to the adaptation of teachers. It is also essential to maintain that they adapt to new technology during the in-service training period. To best understand teachers’ adoption for the MBA technology, it is essential to understand their intentions. Accordingly, earlier studies (e.g. Nikou & Economides, 2017a; Saputri et al., 2021) realizing individuals’ MBA acceptance as being stimulated by volitional and non-volitional motives utilized the Theory of Planned Behaviour (TPB; Ajzen, 1991), while researchers who consider the acceptance motivational or belief-related motives mostly used Technology Acceptance Model (TAM, Davis, 1989), and Self-Determination Theory (SDT, Deci & Ryan, 1985). Past studies on this topic made a significant contribution to the literature in understanding individuals’ MBA acceptance (Nikou & Economides, 2017a, 2017b; Nikou & Economides, 2019). However, to the best of our understanding, there is no study investigating pre-service and in-service teachers’ MBA adoption testing a proposed model within the framework of TAM, TPB, and SDT. In this context, the present study aims to fill this gap by proposing a comprehensive model that predicts pre-service and in-service teachers’ behavioural intentions to use MBA. Therefore, this study proposes a model that combines both motivation and acceptance factors to predict teachers’ behavioural intentions to use MBA by combining SDT, TPB and TAM. In this context, in line with the information we obtained from the literature, we predict that teachers’ perceived competence, perceived autonomy, perceived relatedness levels have an effect on perceived usefulness and perceived ease of use, and these variables affect the attitudes of pre-service teachers. We assume that along with the attitude, the subjective norm and the perceived behavioural control also have an effect on the intention. With the variables we obtained from SDT, TPB and TAM and the model we established, we aim to reveal the factors that affect teachers’ intention to use MBA. Thus, we aim to develop a proposal for teachers to take measures to increase their intention to use MBA technologies and to focus on the variables that have an effect on the model. In this vein, the proposed model would provide a useful reference for stakeholders such as education policy makers, teacher training programmes, and

schools to design effective strategies to increase the adoption of MBA technologies among pre-service and in-service teachers. The results of the study would help educators to better understand the factors that affect the adoption of technology and guide them in the development of programmes that enhance teachers' motivation and acceptance of MBA. In light of this, this study is expected to contribute to the improvement of teacher education programmes and the integration of technology in education.

The rest of this paper is structured as follows: In the next section, we will provide a literature review of relevant studies on the topic. This will be followed by a description of our research methodology and data collection process. In the following section, we will present our findings and conduct a thorough analysis of the results. After that, we will discuss the implications of our findings. Finally, we will conclude with a summary of our results and suggestions for future research. Throughout the paper, we aim to provide a comprehensive and thorough analysis of the topic at hand.

## **2. Literature review**

### **2.1. Mobile-based assessment**

Mobile learning, a concept that emerged with the use of mobile technology in education is an effective way for enhancing students' academic success, motivation and learning attitudes (Lee et al., 2022; Wu et al., 2012). Therefore, mobile learning included many activities that support learning like assessment (Bacca-Acosta & Avila-Garzon, 2021). Assessment is an essential activity that includes both evaluating and encouraging student success. Standard assessment practices test lower-level cognitive abilities and may not necessarily be sufficient for measuring problem-solving, creative and teamwork abilities, which are often perceived to be essential skills (Nikou & Economides, 2018). In literature, it is reported that the assessment practices should be redesigned based on contemporary learning theories in order to include various types of information and reflect what students actually know and are capable of (Nikou & Economides, 2018; Yu et al., 2022). As mobile devices offer new opportunities for learning appraisal and can be used to evaluate high-level abilities (Wu et al., 2012), the MBA has come to the fore (Nikou & Economides, 2017a). MBA which means to support assessment activities with mobile devices (Bacca-Acosta et al., 2022; Muljani & Suwartono, 2022; Nikou & Economides, 2017a, 2017b;), has become an active research area in recent years (Bacca-Acosta & Avila-Garzon, 2021).

The MBA covers mobile device use by providing new functions and opportunities to evaluate learning (Nikou & Economides, 2017a). MBA has begun to reveal as an alternative method of assessment to existing tests (Johnson et al., 2016). There are several benefits of using mobile technologies in the assessment. These offer opportunities to evaluate learning, thanks to features such as personalization, communication, adaptability, ubiquity, interaction, collaboration and to solve the problem of space and time between teachers and students (Herwin et al., 2022; Nikou & Economides, 2018). With mobile devices, many types of assessments such as self and peer-assessments, formative assessments, adaptive, and personalized assessments can be used (Hwang & Chang, 2011). Besides, mobile devices can support competency-based assessments and game-based assessments (Wang, 2015). Although there are advantages provided by mobile technologies, it is known that there are some disadvantages. These can be listed as small screen size, high cognitive load, and difficulty concentrating (Ahmad Faudzi et al., 2023; Nikou & Economides, 2017a). Besides, studies in the literature on the perceptions of students regarding MBA are also incoherent (Bennett et al., 2017). In this context, this study will contribute to MBA studies.

### **2.2. Acceptance of mobile-based assessment**

User acceptance is important for the effective implementation of an information system. Therefore, research on the topic of mobile learning acceptance is gradually ongoing in the field of education

literature (Ateş & Garzón, 2022; Nikou & Economides, 2017a; Sungur-Gül & Ateş, 2021). To enhance educational outcomes, it is crucial to examine the variables that affect MBA acceptance (Nikou & Economides, 2017a). Bacca-Acosta et al. (2022) stated that MBA acceptance studies are limited in the literature. As the MBA offers advantages such as easier administration of the assessment process, independence from time and place, ubiquity, personalization and social interaction (Nikou & Economides, 2017b), it is important to analyse the acceptance of the MBA.

There are many acceptance models in the literature, however; TAM stands out among these models since it points out as a rooted model based on a user's psychological experience with technology. This model influences how individuals use and implement information technologies (Davis, 1989; Kemp et al., 2022). Many external variables have been applied to TAM since its first use of mobile learning research to explain and measure the adoption of mobile learning systems (Nikou & Economides, 2017a). Besides, TPB is another theory often used in literature to examine the intended use of users. This theory is commonly used in studies aimed at better considering the intention role in changing individuals' actions (Ajzen & Manstead, 2007; Zhou et al., 2022b). While TAM is generally recognized as a method for interpreting the determinants of the individuals' intentions to adopt technology (Sungur-Gül & Ateş, 2022), TPB presented developers with more detailed guidance (Teo et al., 2016). Another major factor affecting user adoption of technology is the motivation (Davis et al., 1989; Zhou et al., 2022b). It is mentioned in the literature that SDT will provide an affective theoretical structure for mobile-based learning. Also, this theory is suitable to examine factors that influence users' intentions to use mobile devices (Nikou & Economides, 2017b). Therefore, the SDT motivation framework is used with other acceptance theories in this study. According to the literature, the correlation between SDT and technology acceptance has been confirmed (Fathali & Okada, 2018; Lu et al., 2019). Davis et al. (1989) have also emphasized that motivation and self-determination are crucial to accept a system for users. Besides, many recent studies have been combined TAM and SDT to reveal the adoption of users to new technologies (Luo et al., 2021; Racero et al., 2020; Rosli & Saleh, 2022; Tsai et al., 2021). There are many studies in the literature about the adoption of the MBA. However, these studies were mostly based on the only SDT, Unified Theory of Acceptance and Use of Technology (UTAUT) or TAM (Nikou & Economides, 2014b; Nikou & Economides, 2017a; Saputri et al., 2021). There are some studies examining technology adoption based on combining both TAM and SDT (Nikou & Economides, 2014a; Nikou & Economides, 2017b). While most of these studies examined the acceptance of university students (Nikou & Economides, 2014a; Nikou & Economides, 2014b; Nikou & Economides, 2017b), some of them examined the acceptance of high school students and teachers (Saputri et al., 2021).

## **2.3. The research model and hypotheses**

### **2.3.1. Self-Determination theory (SDT)**

SDT, a modern motivation theory, presumes that people have the potential to be intrinsically motivated. Extrinsic and intrinsic motivation are the two basic types of motivation identified by the theory (Deci & Ryan, 1985; Deci & Ryan, 2002; Good et al., 2022; Ryan & Deci, 2000a, 2000b). Extrinsic motivation relates to the success of an activity to obtain a separable result (Ryan & Deci, 2000a). Extrinsic motivation is a type of motivation that covers behaviours made for reasons other than intrinsic satisfaction, as opposed to intrinsic motivation (Gomez et al., 2022; Ryan & Deci, 2020c). Intrinsic motivation is a form of motivation that contributes to action that is intrinsically fascinating and enjoyable (Gomez et al., 2022; Nikou & Economides, 2017b). Intrinsic motivation inspires an individual to carry out an activity for his or her own sake (Ryan & Deci, 2000a). It is a result of the natural tendency of an individual to follow cognitive and social development. The predominant cause of pleasure and innate drive for humans is the intrinsic motivation (Ryan, 1995). Intrinsic motivation also contributes to higher success and fulfilment than extrinsic motivation (Deci et al., 1989; Good et al., 2022; Williams et al., 1996). SDT claims that when the three fundamental human psychological conditions of autonomy, competency and relatedness are reached, intrinsic motivation is supported (Deci &

Ryan, 1985). Autonomy refers to people's ability to manage their actions and control themselves. Competency is defined as the ability to carry out a task successfully and professionally in carrying out an activity or engagement with the environment (Deci & Ryan, 1985). Relatedness refers to people's need to be connected and related to others. In this context, hypotheses were formed on these three variables in the model in the study.

**2.3.1.1. Perceived competence (PC).** Competence can be defined as being effective in their desires when they participate in a learning activity (Nikou & Economides, 2017b). PC is similar to the term of self-efficacy defined by Bandura (1986, p. 391) as people's judgments about their ability to organize and implement the action plans required to achieve the specified types of performance (Fathali & Okada, 2018; Roca & Gagné, 2008). Self-efficacy shares common characteristics with PC in SDT (Roca & Gagné, 2008). PC reflects individuals' belief in their ability to successfully perform an action and reach their goals (Deci & Ryan, 1985; Fathali & Okada, 2018). PC in technology-enhanced environments is also related to users' PU and PEU (Luo et al., 2021). It has been stated in the literature that PC has a direct effect on the PU of pre-service teachers (Teo et al., 2009). Besides, it is known that PC has a direct effect on teachers' PEU (Sørebø et al., 2009). Roca and Gagné (2008) stated that competence supports increases the individuals' PU and PEU. However, according to Nikou and Economides (2017b), while a significant correlation was revealed between PC and PEU, no relationship was found between PC and PU. In this study, it was expected that PC would affect pre-service and in-service teachers' PU and PEU. Based on the results of previous studies (Petty et al., 2023; Zhang & Zhou, 2022), we hypothesize for the MBA that:

**H1:** PC is positively related to PU.

**H2:** PC is positively related to PEU.

**2.3.1.2. Perceived autonomy (PA).** Autonomy, an essential need for humans, is generally related to positive outcomes. PA can be defined as individuals' desire to self-regulate their actions while using technology. Providing a sense of would increase students' intrinsic and extrinsic motivation (Deci & Ryan, 1985; Fathali & Okada, 2018; Ryan & Deci, 2000a). Learning autonomy can be supported by active learning, especially provided in real contexts (Zhang & Zhou, 2022). It can be said that learning autonomy is a predictor of accepting mobile learning (Liaw & Huang, 2011). In the literature, it is revealed that the PU is affected by PA (Fathali & Okada, 2018; Roca & Gagné, 2008). Also, some studies claimed that the PEU is influenced by PA (Ho, 2010; Roca & Gagné, 2008). However, Fathali and Okada (2018) stated that there is not enough theoretical and empirical support for the relationship between PA and PEU. In this study, it was expected that PA would affect pre-service and in-service teachers' PU and PEU. Based on the results of previous studies, we hypothesize for the MBA that:

**H3:** PA is positively related to PU.

**H4:** PA is positively related to PEU.

**2.3.1.3. Perceived relatedness (PR).** Relatedness indicates the feeling related to peers (Petty et al., 2023). PR is the belief that important people are connected and encouraged (Zhang & Zhou, 2022). In intrinsic motivation, relatedness plays a crucial role because people appear to be internally motivated when they are in a positive and supportive environment (Zhao et al., 2011). Roca & Gagné, 2008 stated that learners who feel associated with important individuals view learning as useful. Nikou and Economides (2017b) revealed that the relatedness affected students' PEU and PU of the learning activity. Nikou and Economides (2017a) found out that social influence influenced PU, which PR represents some kind of social influence (Roca & Gagné, 2008). Individuals may also want to appreciate the opinions of their parents, teachers, or others, which influence their behaviour



regarding the system's usefulness (Hunde et al., 2023; Mijić & Ćebić, 2023; Yang et al., 2023). In this study, it was expected that PR would affect pre-service and in-service teachers' PU and PEU. Based on the results of previous studies, we hypothesize for the MBA that:

**H5:** PA is positively related to PU.

**H6:** PA is positively related to PEU.

### **2.3.2. Technology acceptance model (TAM)**

The TAM is a well-established model of how technology is accepted by users (Davis, 1989). TAM has also been successfully used as a tool to investigate the acceptance of mobile learning (Al-Bashayreh et al., 2022; Al-Rahmi et al., 2022; Camilleri & Camilleri, 2022) and has provided predictive and explanation ability to a significant number of studies on mobile learning (Nikou & Economides, 2017a). There are variables in the TAM framework that describe the acceptance of the device in terms of PU, PEU and attitude (Davis, 1989). PU is described as the degree to which an individual assumes that it will improve job efficiency by using a specific system. PEU is defined as the degree to which one feels it would be simple to use the system. In this model, attitude affects the behavioural intent to use a system as well as the indirect and direct impact of PU and PEU. PEU is a crucial factor affecting the perceptions of users towards using technologies (Chahal & Rani, 2022; Hsu & Lin, 2022).

**2.3.2.1. Perceived ease of use (PEU).** PEU is described as the degree to which a system is easy to use (Davis, 1989). A system's perceived ease of use refers to the minimal effort potential users perceive it to take to use it (Davis et al., 1989). Perceived ease of use leads to the belief that computers are simple to comprehend and to use, and that by utilizing the system, a person will believe that it is easy to learn, to implement, and to operate (Asmara & Ratmono, 2021). PEU and PU have been shown to have a significant impact on the acceptance of mobile learning (Al-Rahmi et al., 2022; Camilleri & Camilleri, 2022). When users believe information system is simple to use and useful, they are more likely to use it (Şimşek & Ateş, 2022). PEU can be predictive of a system's PU according to TAM (Davis, 1989; Venkatesh & Davis, 2000). In other words, for a system to be perceived and implemented as useful, it should be firstly simple to use (Park et al., 2014). Research showed that PEU affected PU and attitude (Al-Dokhny et al., 2021; Ateş & Garzón, 2022; Liao et al., 2022). Although the correlation between PEU and attitude has not been tested in several studies, it has been revealed that PEU affects PU (Fussell & Truong, 2021; Zhou et al., 2022a). In this study, it was expected that PEU would affect pre-service and in-service teachers' PU and attitude. Based on the results of previous studies, we hypothesize for the MBA that:

**H7:** PEU is positively related to PU.

**H8:** PEU is positively related to attitude.

**2.3.2.2. Perceived usefulness (PU).** PU is described as how an individual presumes that using a specific system will improve job efficiency (Davis, 1989). PU reflects the value users place on that system to enhance their performance (Fathali & Okada, 2018). In terms of teachers, it can be said that PU is the degree to which a teacher feels that using technology can increase the efficiency of their job performance. The PU is considered as an extrinsic motivation factor (Roca & Gagné, 2008). When users believe a new technology as useful, they are encouraged to adopt it and willing to use the technology. Behavioural intention to use is defined as the level of a teacher's willingness to use technology (Milutinović, 2022; Saidu & Al Mamun, 2022). Some studies have revealed that PU affects attitude (Do et al., 2022), while others have proven that, it affects intention (Fathali & Okada, 2018; Yang et al., 2022). Research showed that PU affected both attitude and behavioural intention (Papakostas et al., 2023; Songkram & Osuwan, 2022). In this study, it was expected that

PU would affect pre-service and in-service teachers' attitude and intention. Based on the results of previous studies, we hypothesize for the MBA that:

**H9:** PU is positively related to attitude.

**H10:** PU is positively related to intention.

**2.3.2.3. Attitude.** Attitude guide the actions of individuals (Ajzen & Fishbein, 2005) and is defined as the degree to which a teacher has positive emotions regarding the use of technology (Teo, 2011). In other words, how teachers view the usefulness of technology in the education and training environment forms beneficial or negative attitudes toward technology use (Teo & Van Schalk, 2009). Behavioural intention is an element of how willing individuals are to perform a behaviour (Ajzen, 1991). Research showed that attitude affected behavioural intention (Wang et al., 2022). Similarly, behavioural intentions are affected by the user's attitude towards technology (Liao et al., 2022; Papakostas et al., 2023; Szymkowiak & Jeganathan, 2022). According to TAM, attitude further affects the intention to adopt (Davis, 1989). In this study, it was expected that attitude would affect pre-service and in-service teachers' intentions. Based on the results of previous studies, we hypothesize for the MBA that:

**H11:** Attitude is positively related to intention

### **2.3.3. Theory of planned behaviour (TPB)**

TPB is a commonly used and validated model that researchers have used over the last twenty years and has been indicated to estimate various intentions (Ajzen, 1991). TPB is used as a robust model to describe the purpose of people to interact with technology (George, 2004). It has been commonly conducted in studies where it is the key focus in understanding the intention role (Ajzen & Manstead, 2007). TPB has the potential to offer a more detailed viewpoint on value structures to educators and scholars (Teo et al., 2016). According to Ajzen (1991), behavioural intentions that are affected by an attitude towards behaviour and subjective norm (SN) determine the actions of an individual. Attitude directs actions and is described as how people react to an object and are disposed of by it. SN is the interpretation of what people who are significant to the person think that the action should be carried out. Behavioural intentions are variables showing how challenging individuals are going to continue to act a behaviour (Ajzen, 1991).

**2.3.3.1. Subjective norm (SN).** Fishbein and Ajzen (1975) defined the SN as perceived demands to perform a certain action on an individual. Namely, if a teacher agrees that using technology is an expectation of management, their desire to use it may be high. The SN is the opinion of a person as to why people who are essential to an individual believe the action should be carried out. For example, an educator may want to use technology since the school administration has mandated it. Namely, SN covers the belief that a person thinks that most of the people who important to him or her should or should not do the behaviour in question (Teo et al., 2016). Some studies showed that there was a correlation between SN and intention (Ateş & Garzón, 2022; Lin et al., 2021; Zhuang et al., 2021). However, Bervell et al. (2022) and Kumar et al. (2020) could not support the relationship between SN and intention. In this study, it was expected that SN would affect pre-service and in-service teachers' intentions. Based on the results of previous studies, we hypothesize for the MBA that:

**H12:** SN is positively related to intention.

**2.3.3.2. Perceived behavioural control (PBC).** PBC is identified as an individuals' understanding of how simple or hard behaviour is to perform (Ajzen, 1991). It refers to the perceived ease or

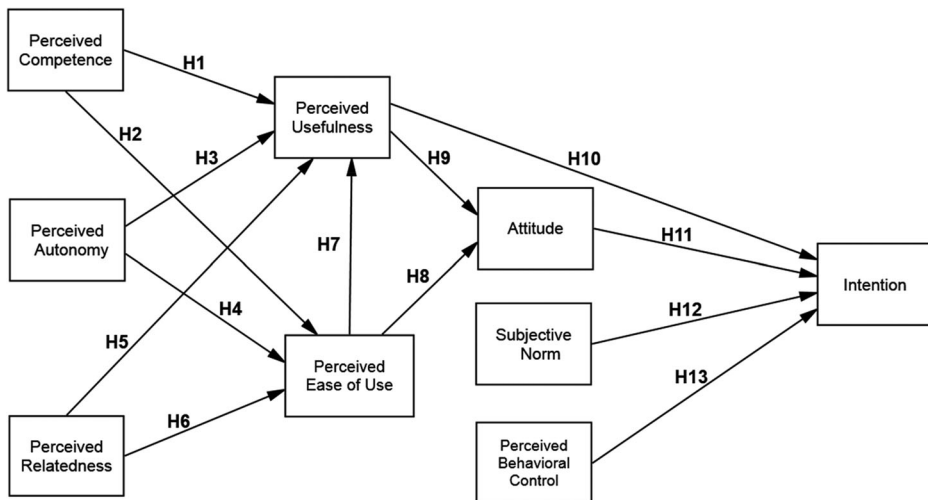


complexity of acting, as well as the degree of influence an individual has over the behaviour's objectives. Perceived external obstacles and personal inadequacies can impair the ability to perform actions and regulate perceptions. In this study, PBC encompasses teachers' perception of how difficult or technologically complex the use of MBA technology is. When individuals perceive technology as complex, the perceived technology negatively affects the ease of use and limits information processing capacity. Control belief like PBC is a view of the availability of skills needed to perform activities such as PEU and technical assistance (Teo & Van Schalk, 2009). In the context of the use of technology, PBC is associated with PEU or perceived difficulty with the technology and PBC is one of the main factors predicting the intention to use the technology (Compeau & Higgins, 1995). The simpler it is to use the system, the higher the expectation that the system will meet its knowledge needs (Teo & Lee, 2010). Research showed that PBC affected behavioural intention (Adanır & Muhametjanova, 2021; Al-Rahmi et al., 2022; Ateş & Garzón, 2023; Teo et al., 2016). Based on the results of previous studies, we hypothesize for the MBA that:

**H13:** PBC is positively related to intention.

Consequently, this study focuses on the adoption and motivational factors that affect both in-service and pre-service teachers' MBA acceptance. Overall, the main goal of our research is to propose a model for both motivational and acceptance factors for predicting their behavioural intentions to use MBA by combining SDT, TPB, and TAM (see Figure 1). In particular, the following objectives were determined for the current study:

1. Propose a model that provides an understanding of pre-service and in-service teachers' intentions to use MBA in classes by combining the TPB, TAM, and SDT into a research model and compare explanatory power of the TBP, TAM, and the proposed model to explain intention to use MBA,
2. Test the relative importance among the variables in the proposed model to understand pre-service and in-service teachers' intentions to use MBA in classes and investigate the mediating role of perceived ease of use (PEU), perceived usefulness (PU) and attitude on pre-service and in-service teachers' intentions to use MBA in classes,
3. Examine the moderating impact of gender and sample type within the proposed conceptual model.



**Figure 1.** Research framework and hypotheses.

### 3. Method

#### 3.1. Sample

The sample for the study consisted of a diverse group of participants, including both pre-service teachers who were pursuing their education in teacher preparation programmes, and in-service teachers who were actively working in schools. This blend of pre-service and in-service teachers provided a comprehensive representation of the teaching profession and allowed for a more thorough examination of the use and perception of mobile-based applications (MBA) in education. MBAs offer a versatile and interactive platform for teachers to access educational resources and improve their pedagogical skills. Additionally, they can help teachers engage students in more dynamic and interactive learning experiences, thereby promoting students' motivation, engagement, and performance. Moreover, MBAs can assist teachers in different aspects of their work such as lesson planning, assessment, and collaboration with peers. By leveraging the power of mobile technology, pre-service and in-service teachers can stay current with advances in teaching and learning and can provide more effective and innovative educational experiences for their students. In the study, the pre-service teachers came from science education, preschool education, and primary education departments, while in-service teachers were employed in science, preschool, and primary schools. The inclusion of these departments ensured a broad range of perspectives and experiences with MBA in education.

Before collecting the data, participants were given a brief explanation of MBA and its use in education. They were instructed to thoroughly read the description and fill out the corresponding scales, which took approximately 30 min to complete. The scales were distributed to 947 participants who are suitable for the research participant profile. After collecting the scales, 146 responses were excluded due to incompleteness or extreme outliers, yielding a final sample of 801 valid responses (84.58% response rate). The participants consisted of both pre-service teachers ( $N = 522$ ) and in-service teachers ( $N = 279$ ). These departments were chosen as mobile applications, such as anatomy 4D, geometry pad, Geogebra classic, and sky map, can effectively be utilized in the education of students between the ages of 3 and 14 (Sungur-Gül & Ateş, 2021). Among the pre-service teachers, 39.25% were male and the majority (55.53%) were in their fourth year of study. 32% of them had previous knowledge about MBA. Considering in-service teachers, 42.51% were male and the average age of the participants was about 26.48 years. With regard to postgraduate education, 19.18% had a master degree and 3.19 had a PhD degree. About 11.35% of in-service teachers stated that they use MBA during students' education.

#### 3.2. Instruments

The scales were adapted from earlier studies to provide content validity of the scales used in the present study (see Table 1) (Hair et al., 2018). During the preparation items involved in TAM, a three-item scale for measuring PEU and a three-item scale for measuring PU were adapted from Davis (1989) and Nikou and Economides (2017b, 2019). Among the TPB, four items of attitude, two items of SN, and three items of PBC were obtained from Ajzen (2006), Lu et al. (2009), and Taylor and Todd (1995). Items of SDT including PC (four items), PA (four items), and PR (four items) were taken from Baard et al. (2004), McAuley et al. (1989) and Nikou and Economides (2017b). Finally, four items measuring intention were derived from Ajzen (2006), Davis (1989), and Nikou and Economides (2017b). As a result, a total of 31 items were used to determine factors affecting pre-service and in-service teachers' intentions to use MBA. All the scales were evaluated using 7-point scales ranging from "strongly disagree" to "strongly agree".

#### 3.3. Procedure

The cross-sectional study design was chosen for data collection in order to gather information from the participants at a single point in time. Convenience sampling was used in this study because it is

**Table 1.** Constructs, items, factor loadings, and sources.

Constructs and Items	Reliability (α)	Factor Loading (EFA)	Factor Loading (CFA)	Source
<i>Perceived Ease of Use</i>	0.81			Davis (1989); Nikou and Economides (2017b)
I find the mobile-based assessment easy to use.		0.79	0.77	
It is easy for me to become skilful at using mobile-based assessment.		0.74	0.76	
My interaction with mobile-based assessment is clear and understandable.		0.72	0.77	
<i>Perceived Usefulness</i>	0.84			Davis (1989); Nikou and Economides (2019)
Using mobile-based assessment increases my productivity.		0.74	0.79	
Using mobile-based assessment is useful for my teaching.		0.71	0.79	
Using mobile-based assessment enhances my effectiveness.		0.73	0.81	
<i>Attitude</i>	0.79			Lu et al. (2009); Taylor and Todd (1995)
It is a good idea to use mobile-based assessment.		0.77	0.76	
I like using mobile-based assessment.		0.79	0.83	
Using mobile-based assessment is a wise idea.		0.76	0.77	
Using the mobile-based assessment would be pleasant.		0.81	0.71	
<i>Subjective Norm</i>	0.80			Ajzen (2006); Lu et al. (2009); Taylor and Todd (1995)
People who are important to me think that I should use mobile-based assessment.		0.80	0.77	
People who influence my behaviour would think that I should use the mobile-based assessment.		0.82	0.86	
<i>Perceived Behavioural Control</i>	0.77			Lu et al. (2009); Taylor and Todd (1995)
Using mobile-based assessment is entirely within my control.		0.79	0.78	
I have the knowledge and ability to use mobile-based assessment.		0.77	0.82	
I am able to skilfully use mobile-based assessment.		0.80	0.84	
<i>Perceived Competence</i>	0.75			Baard et al. (2004); McAuley et al. (1989); Nikou and Economides (2017b)
I am pretty good at the mobile-based assessment.		0.77	0.74	
I am pretty well at the mobile-based assessment compared to other pre-service/in-service teachers.		0.70	0.72	
After working at the mobile-based assessment for a while, I can feel pretty competent.		0.78	0.77	
The mobile-based assessment is an activity that I can do very well.		0.77	0.79	
<i>Perceived Autonomy</i>	0.89			Baard et al. (2004); McAuley et al. (1989); Nikou and Economides (2017b)
I feel a sense of choice and freedom while participating in the mobile-based assessment.		0.81	0.84	
I feel pressured during the mobile-based assessment.		0.84	0.81	
The mobile-based assessment provides me interesting options and choices.		0.79	0.76	
There is not much opportunity for me to decide for myself how to do the mobile-based assessment.		0.82	0.80	
<i>Perceived Relatedness</i>	0.82			Baard et al. (2004); McAuley et al. (1989); Nikou and Economides (2017b)
I have the opportunity to be close to others (pre-service/in-service teachers) when I participate in the mobile-based assessment.		0.80	0.78	
I feel close to others when I participate in the mobile-based assessment.		0.79	0.71	
I feel connected with my classmates/colleagues when I participate in the mobile-based assessment.		0.71	0.75	
I feel really distant to my classmates/colleagues when I participate in the mobile-based assessment.		0.75	0.82	

(Continued)

**Table 1.** Continued.

Constructs and Items	Reliability ( $\alpha$ )	Factor Loading (EFA)	Factor Loading (CFA)	Source
<i>Intention</i>	0.87			
I predict I would use mobile-based assessment in the future.		0.84	0.88	Ajzen (2006); Davis (1989); Nikou and Economides (2017b)
I plan to use mobile-based assessment in the future.		0.79	0.81	
I intend to use mobile-based assessment in the future.		0.85	0.81	
I will try to use mobile-based assessment in the future.		0.86	0.79	

Note:  $\alpha$  = Cronbach's alpha, EFA: Exploratory factor analysis, CFA: Confirmatory factor analysis.

an efficient and practical method of collecting data from a large population. This type of sampling is often used when the researcher is limited by time and resources and needs to quickly gather data from a population that is easily accessible (Cohen et al., 2007). In the case of this study, the sample of pre-service and in-service teachers can be easily accessible, making convenience sampling a suitable choice. By selecting participants from similar cities, the study aimed to ensure a consistent and reliable sample, thereby increasing the internal validity of the data. Pre-service teachers, who are undergraduate students pursuing their education at the faculty of education, were a key focus of the study. They are the future teachers who will be responsible for educating young students in the country. In-service teachers, on the other hand, are teachers who are already working in elementary schools and have practical experience in the field. By including both pre-service and in-service teachers in the study, the researchers aimed to gather a comprehensive understanding of the attitudes and practices surrounding MBA in education in Turkey. The study participants were given a comprehensive explanation of MBA and its practices in education prior to the data collection process. This was to ensure that they fully understood the topic being studied and could provide informed responses. The data collection process was carried out using scales, which the participants were asked to fill out after carefully reading the description of MBA and its practices. The completion of the scales took approximately 30 min per participant. In conclusion, the data collection process in this study was carefully planned and carried out to ensure that a reliable and valid sample of participants was obtained.

### 3.4. Data analysis

During the analysis, measurement and structural models were tested (Anderson & Gerbing, 1988). Measurement model includes the reliability and validity of the constructs while, analyses of the goodness of fit and hypothesis testing were examined during the testing of the structural model (Hair et al., 2018).

During the measurement model, confirmatory factor analysis (CFA) was used to test the reliability and validity of the proposed model using a maximum likelihood estimation method. The results of CFA demonstrated an acceptable fit to the data ( $\chi^2 = 544.78$ ,  $df = 223$ ;  $\chi^2/df = 2.44$ ;  $GFI = 0.93$   $IFI = 0.94$ ,  $TLI = 0.91$   $CFI = 0.95$ ;  $RMSEA = 0.04$ ;  $SRMR = 0.03$ ). The reliability of the constructs was assessed with Cronbach's alpha values (Fornell & Larcker, 1981). As demonstrated in Table 2, Cronbach's alpha values of constructs were between 0.75 and 0.89 and since these values were higher than 0.70, it can be concluded that the values showed satisfactory internal consistency reliability (Hair et al., 2018).

Construct validity was provided through convergent validity and discriminant validity using three parameters: Factor Loadings (FL), Average Variance Extracted (AVE), and Composite Reliability (CR) (see Table 1 and Table 2). FL ranged from 0.71–0.88 were more than the suggested value of at least 0.50 (Hair et al., 2018). Further, the analysis revealed that AVE ranging from 0.57–0.68 exceeded the acceptable limit of 0.5 (Hair et al., 2018) and CR ranging from 0.80–0.89 was above the threshold

**Table 2.** Descriptive statistics, convergent and discriminant validity and correlation values.

No	Constructs	No. of items	Mean	SD	AVE	CR	1	2	3	4	5	6	7	8	9
1	PEU	3	5.05	0.98	0.59	0.81	<b>0.77</b>								
2	PU	3	5.19	0.88	0.63	0.84	0.56	<b>0.79</b>							
3	ATT	4	5.12	1.07	0.59	0.85	0.48	0.39	<b>0.77</b>						
4	SN	2	5.33	1.02	0.67	0.80	0.36	0.27	0.21	<b>0.82</b>					
5	PBC	3	5.12	0.87	0.66	0.85	0.38	0.31	0.35	0.22	<b>0.81</b>				
6	PC	4	5.01	0.97	0.57	0.84	0.40	0.39	0.22	0.38	0.35	<b>0.75</b>			
7	PA	4	4.98	1.13	0.64	0.88	0.33	0.21	0.26	0.24	0.29	0.27	<b>0.80</b>		
8	PR	4	4.92	1.14	0.59	0.85	0.28	0.32	0.39	0.34	0.25	0.39	0.31	<b>0.77</b>	
9	INT	4	4.98	0.92	0.68	0.89	0.35	0.39	0.22	0.36	0.28	0.24	0.28	0.35	<b>0.82</b>

Note: Bold values indicate the square of AVE, SD = Standard Deviation.

value of 0.6 (Bagozzi & Yi, 2012). The results indicated that convergent validity was provided by the whole measurement model of the study. On the other hand, the results of discriminant validity showed that the square root of the AVE was higher than the all correlation between constructs.

## 4. Results

### 4.1. Structural model: goodness of fit results

This study combined TPB, TAM and SDT to explain pre-service and in-service teachers' intention to use MBA. In addition, TPB and TAM have an influence on intention, while constructs of SDT is regarded as additional variables in the conceptual research model since construct of SDT has no hypothetical relationship with intention. Therefore, while conducting model comparison, three types of explanatory power were calculated including TPB, TAM and combined model. SEM results indicated good fit of the model. The original TPB and TAM model have acceptable fit to the data. Therefore, the combined model ( $\chi^2/df = 2.50$ ) had a better fit than TPB ( $\chi^2/df = 2.53$ ) and TAM ( $\chi^2/df = 2.67$ ). Moreover, the proposed conceptual model had a better explanatory power ( $R^2 = 0.46$ ) than TPB ( $R^2 = 0.40$ ) and TAM ( $R^2 = 0.37$ ). These results are indicated in Table 3.

### 4.2. Hypothesis testing results

Structural model testing results indicated in Figure 2 showed that PC ( $\beta = 0.25, p < 0.01$ ), PA ( $\beta = 0.23, p < 0.01$ ), and PR ( $\beta = 0.35, p < 0.001$ ) were positively and significantly related to PEU. In addition, these constructs had positive relationship with PU ( $\beta_{PC} = 0.17, p < 0.01$ ;  $\beta_{PA} = 0.48, p < 0.001$ ;  $\beta_{PR} = 0.22, p < 0.01$ ). Therefore, the following hypotheses between H1 and H6 were supported. Among the TAM constructs, PEU was found to significantly influence the PU ( $\beta = 0.37, p < 0.001$ ) and attitude toward the use of MBA in classes ( $\beta = 0.46, p < 0.001$ ). Further, the proposed relationship between PU and attitude ( $\beta = 0.34, p < 0.01$ ) and intention to use MBA ( $\beta = 0.44, p < 0.001$ ) was found. Thus, these findings supported H7, H8, H9, and H10. Finally, attitude ( $\beta = 0.22, p < 0.01$ ), SN ( $\beta = 0.30, p < 0.01$ ), and PBC ( $\beta = 0.43, p < 0.001$ ) had a positive and significant impact on intention to use MBA in classes which supported hypothesis H11, H12 and H13. While PC, PA, PR and PEU explained about 21% of the total variance in the PU, the PC, PA, PR explained approximately 23% of the total variance in PEU. In addition, about 38% of the total variance in attitude was explained by PEU and PU. Finally, about 46% of the variance in intention was explained by the constructs of TPB including attitude, SN, and PBC.

### 4.3. Testing the indirect effects

SEM results involved in Table 4 related to indirect effects showed that PEU ( $\beta = 0.29, p < 0.01$ ) affected attitude through PU. It was also found that PU ( $\beta = 0.26, p < 0.01$ ) and PEU ( $\beta = 0.21, p <$

**Table 3.** Goodness Fit Data and explanatory power of the model of TAM, TPB and Combined Proposed Model.

Goodness Fit Statistics & $R^2$	TAM	TPB	Combined Proposed Model	Reference Range
$\chi^2$	379.22	344.25	781.15	N. A
df	142	136	312	N. A
$\chi^2/df$	2.67	2.53	2.50	>1 and < 5
CFI	0.94	0.95	0.96	$\geq 0.90$
GFI	0.90	0.92	0.93	$\geq 0.90$
IFI	0.91	0.93	0.94	$\geq 0.90$
TLI	0.90	0.91	0.92	$\geq 0.90$
SRMR	0.06	0.05	0.03	$\leq 0.08$
RMSEA	0.05	0.04	0.04	$\leq 0.08$
$R^2$ (Adjusted)Intention	0.37	0.40	0.46	N. A

Note: Source: Bagozzi and Yi (2012) and Browne and Cudeck (1993).



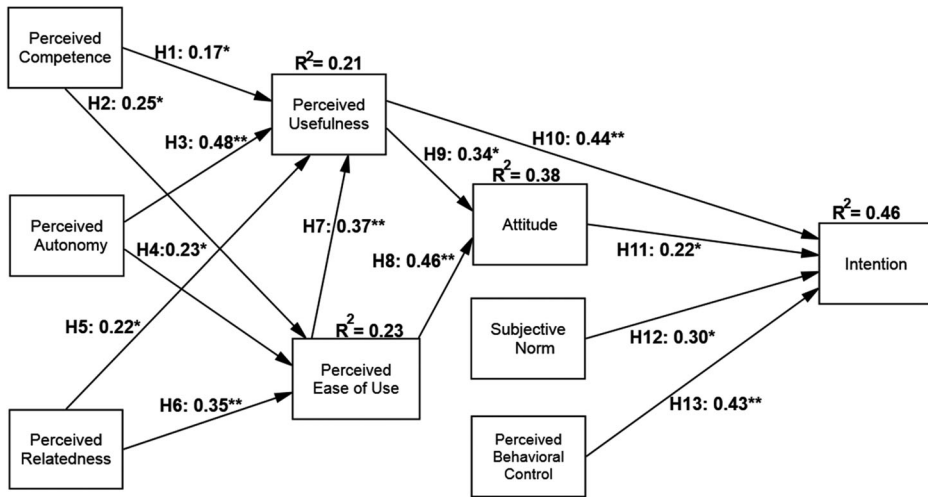


Figure 2. The SEM results, \* $p < 0.01$ , \*\* $p < 0.001$ .

0.01) had significant indirect influence on intention through attitude. In addition, there was an indirect effect of PC ( $\beta = 0.21, p < 0.01$ ), PA ( $\beta = 0.19, p < 0.05$ ) and PR ( $\beta = 0.24, p < 0.01$ ) on attitude through PU and PEU. Finally, PC ( $\beta = 0.15, p < 0.05$ ), PA ( $\beta = 0.14, p < 0.05$ ) and PR ( $\beta = 0.20, p < 0.01$ ) were significantly related to intention through PU.

#### 4.4. Testing the moderating effects of gender and sample type

To examine moderating impact of gender and sample type, the invariance test for measurement and structural models were conducted. There were 323 males and 478 females and 522 pre-service teachers and 279 in-service teachers attended to the study. In the first stage, two non-restrict models were prepared for gender and sample type. The model for gender and sample type generated a good fit to the data. In addition, the results of full-metric invariance model showed adequate fit for gender and sample type. Findings indicating chi-square difference test demonstrated that no significant difference was found between two models for gender ( $\Delta\chi^2(24) = 26.67, p > 0.01$ ) and sample type ( $\Delta\chi^2(23) = 38.68, p > 0.01$ ). Accordingly, the full-metric invariance was supported.

Then, proposed paths were added to the full-metric invariance model and thus, a baseline model was generated. The results toward the path analysis indicated that the baseline model has acceptable fit for gender ( $\chi^2/df = 2.02, CFI = 0.92, IFI = 0.93, TLI = 0.91, RMSEA = 0.044$ ) and sample type ( $\chi^2/df = 2.02, CFI = 0.93, IFI = 0.94, TLI = 0.92, RMSEA = 0.041$ ). Lastly, the model was compared to the nested models and the findings toward chi-square difference test for gender showed that significant differences were found between PA and PU ( $\Delta\chi^2(1) = 5.43, p < 0.01$ ), PR, and PEU ( $\Delta\chi^2(1) = 4.45, p < 0.01$ ), PEU and PU ( $\Delta\chi^2(1) = 3.44, p < 0.01$ ), PEU and attitude ( $\Delta\chi^2(1) = 3.68, p < 0.01$ ), PU and intention

Table 4. Indirect relationships.

Indirect effect of	On	
	Attitude	Intention
Perceived Usefulness	–	0.26*
Perceived Ease of Use	0.29*	0.21*
Perceived Competence	0.21*	0.15**
Perceived Autonomy	0.19**	0.14**
Perceived Relatedness	0.24*	0.20*

Note: \*Significant at 0.01, \*\* Significant at 0.05.

( $\Delta\chi^2(1) = 3,44, p < 0.01$ ), and SN and intention ( $\Delta\chi^2(1) = 3,87, p < 0.01$ ). For sample type, it was found that there was only a significant difference between PA and PU ( $\Delta\chi^2(1) = 4.89, p < 0.01$ ). More details about the structural invariance test are indicated in Table 5 and Table 6 for gender and sample type, respectively.

## 5. Discussion and implications

The current study synthesized SDT, TPB, and TAM into a unified framework to explain the intentions of both in-service and pre-service teachers to use MBA. The theoretical linkages were found to be significant, and the mediating roles of perceived usefulness, perceived ease of use, and attitude were also determined to be significant. Furthermore, gender was found to be a moderator variable in the proposed model. These results provide significant contributions to the educational technology literature regarding teachers' MBA usage intentions, emphasizing the individual, social, and motivational roles. Finally, the findings of this study can be utilized to devise effective e-learning strategies that can help teachers improve their expertise in the field of MBA-based educational activities.

### 5.1. Theoretical and practical implications

The present study provides both theoretical and practical implications for understanding the drivers of teachers' intentions to use MBA. Within our knowledge, the study was the first attempt to converge three outstanding theories/models to understand teachers' intentions to use MBA. Among them, SDT was widely confirmed in earlier studies to explain intrinsic and extrinsic motivations of teachers (White et al., 2021). TPB, on the other hand, was carried out in different contexts including teachers' e-learning behaviours (Ateş & Garzon, 2022). TAM, a pioneer model in the field, has also been applied to explain teachers' e-learning behaviours (Rafique et al., 2023; Scherer et al., 2019). In the present study, a conceptual framework was proposed based on SDT, TPB, and TAM to understand teachers' MBA usage intentions in their classes. These three models/theories were combined

**Table 5.** The outcome of the gender-related invariance test for both the measurement and structural models.

Groups	Models	$\chi^2$	df	RMSEA	CFI	IFI	TLI	$\Delta\chi^2$	Full-metric invariance
Male and Female	Non-restricted model	1826.24	954	0.042	0.93	0.94	0.92	$\Delta\chi^2(24) = 26.67, p > 0.01$ (insignificant)	supported
	Full-metric invariance	1852.91	978	0.043	0.92	0.92	0.91		
		Male (n = 323)		Female (n = 478)		Baseline model (Freely estimated)		Nested model (Constrained to be equal)	
Paths	$\beta$	t-values	B	t-values					
PC→PU	0.18	2.11*	0.17	2.36*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2012.45^a$		
PC→PEU	0.22	2.89*	0.28	4.12*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2013.93^b$		
PA→PU	0.26	3.54**	0.56	7.98**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2017.79^c$		
PA→PEU	0.20	2.38*	0.28	4.32*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2013.85^d$		
PR→PU	0.24	3.27**	0.20	2.79*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2013.32^e$		
PR→PEU	0.20	2.42*	0.41	6.58**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2016.81^f$		
PEU→PU	0.28	4.02**	0.49	7.17**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2015.8^g$		
PEU→ATT	0.30	4.36**	0.51	7.43**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2016.04^h$		
PU→ATT	0.37	5.12**	0.31	4.88**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2013.51^i$		
PU→INT	0.28	4.10**	0.52	7.58**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2015.8^j$		
ATT→INT	0.19	2.29*	0.24	3.58*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2012.58^k$		
SN→INT	0.38	5.39**	0.17	2.40*	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2016.23^l$		
PBC→INT	0.41	6.03**	0.48	6.88**	$\chi^2(998) = 2012.36$		$\chi^2(999) = 2013.78^m$		

<sup>a</sup> $\Delta\chi^2(1) = 0.09, p > 0.05$  (insignificant) <sup>b</sup> $\Delta\chi^2(1) = 1.57, p > 0.05$  (insignificant) <sup>c</sup> $\Delta\chi^2(1) = 5.43, p < 0.05$  (significant)

<sup>d</sup> $\Delta\chi^2(1) = 1.49, p > 0.05$  (insignificant) <sup>e</sup> $\Delta\chi^2(1) = 0.96, p > 0.05$  (insignificant) <sup>f</sup> $\Delta\chi^2(1) = 4.45, p < 0.05$  (significant)

<sup>g</sup> $\Delta\chi^2(1) = 3.44, p < 0.05$  (significant) <sup>h</sup> $\Delta\chi^2(1) = 3.68, p < 0.05$  (significant) <sup>i</sup> $\Delta\chi^2(1) = 1.15, p > 0.05$  (insignificant)

<sup>j</sup> $\Delta\chi^2(1) = 3.44, p < 0.05$  (significant) <sup>k</sup> $\Delta\chi^2(1) = 0.22, p > 0.05$  (insignificant) <sup>l</sup> $\Delta\chi^2(1) = 3.87, p < 0.05$  (significant)

<sup>m</sup> $\Delta\chi^2(1) = 1.42, p > 0.05$  (insignificant)

\* $p < 0.05$ , \*\* $p < 0.01$ .

**Table 6.** The outcome of the sample type-related invariance test for both the measurement and structural models.

Groups	Models	$\chi^2$	df	RMSEA	CFI	IFI	TLI	$\Delta\chi^2$	Full-metric invariance	
Pre-service and in-service teachers	Non-restricted model	1621.44	878	0.044	0.94	0.95	0.93	$\Delta\chi^2(23) = 38.68$ , $p > 0.01$ (insignificant)	supported	
	Full-metric invariance	1660.12	901	0.045	0.93	0.93	0.92			
	Pre-service teachers ( $n = 522$ )	In-service teachers ( $n = 279$ )		Baseline model (Freely estimated)			Nested model (Constrained to be equal)			
Paths	$\beta$	$t$ -values	B	$t$ -values						
PC→PU	0.16	2.30*	0.19	3.39*	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1846.83^a$		
PC→PEU	0.23	3.55*	0.29	4.84*	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.83^b$		
PA→PU	0.37	4.89**	0.52	6.94**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1850.47^c$		
PA→PEU	0.21	3.26*	0.29	4.76*	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.3^d$		
PR→PU	0.19	2.65*	0.27	4.42*	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1846.93^e$		
PR→PEU	0.33	4.55**	0.39	5.36**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.13^f$		
PEU→PU	0.36	4.61**	0.40	5.50**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.58^g$		
PEU→ATT	0.47	5.75**	0.42	5.78**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.71^h$		
PU→ATT	0.32	4.22**	0.39	5.43**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.46^i$		
PU→INT	0.45	5.40**	0.42	5.85**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.31^j$		
ATT→INT	0.19	3.01*	0.29	4.81*	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.87^k$		
SN→INT	0.28	3.97*	0.37	5.12**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1845.69^l$		
PBC→INT	0.47	5.81**	0.38	5.25**	$\chi^2(915) = 1845.58$			$\chi^2(914) = 1847.05^m$		

<sup>a</sup> $\Delta\chi^2(1) = 1.25$ ,  $p > 0.05$  (insignificant)  
<sup>b</sup> $\Delta\chi^2(1) = 2.25$ ,  $p > 0.05$  (insignificant)  
<sup>c</sup> $\Delta\chi^2(1) = 4.89$ ,  $p < 0.05$  (significant)  
<sup>d</sup> $\Delta\chi^2(1) = 1.72$ ,  $p > 0.05$  (insignificant)  
<sup>e</sup> $\Delta\chi^2(1) = 1.35$ ,  $p > 0.05$  (insignificant)  
<sup>f</sup> $\Delta\chi^2(1) = 1.55$ ,  $p > 0.05$  (insignificant)  
<sup>g</sup> $\Delta\chi^2(1) = 2.00$ ,  $p > 0.05$  (insignificant)  
<sup>h</sup> $\Delta\chi^2(1) = 2.13$ ,  $p > 0.05$  (insignificant)  
<sup>i</sup> $\Delta\chi^2(1) = 1.88$ ,  $p > 0.05$  (insignificant)  
<sup>j</sup> $\Delta\chi^2(1) = 1.73$ ,  $p > 0.05$  (insignificant)  
<sup>k</sup> $\Delta\chi^2(1) = 2.29$ ,  $p > 0.05$  (insignificant)  
<sup>l</sup> $\Delta\chi^2(1) = 0.11$ ,  $p > 0.05$  (insignificant)  
<sup>m</sup> $\Delta\chi^2(1) = 1.47$ ,  $p > 0.05$  (insignificant)  
 \* $p < 0.05$ , \*\* $p < 0.01$ .

into a conceptual model by considering the correlations among their main variables. The theoretical model was supported by the data as a robust model of pre-service and in-service teachers’ intentions to use MBA, which has critical implications in that it indicates how motivational, social, and self-interest factors affect such a technological adaptation process.

The result of the study showed that the original constructs of SDT, TPB, and TAM together explained 46% of the variance in intention which is bigger than that for the TPB (40%), and TAM (37%) suggesting that the combination of the three theories was found to be a better explanation of the intention to use mobile-based assessment than either TPB or TAM alone. In addition, the results of the study suggest that the TPB provides a better explanation of the variance in understanding the intention of pre-service and in-service teachers’ use of MBA compared to the TAM. This highlights the importance of including non-volitional determinants in the context of e-learning. The study is unique in combining motivational, volitional, and non-volitional factors to form a comprehensive model for explaining the intention to use MBA. The proposed conceptual model is deemed to be well-rounded, feasible, and powerful, making it useful for further model developments in a wide range of e-learning contexts.

The findings are in line with the results of earlier studies comparing TPB and TAM (e.g. Cheng, 2019; Zhou et al., 2022b). Regarding the relative importance of constructs of SDT, as hypothesized from H1 to H6, it was revealed that PC, PA, and PR had an influence on PU and PEU and explained them with the variance of 21% and 23%, respectively. The findings imply that teachers with strong confidence about using MBAs for classes are likely to have a high degree to which they believe that using MBAs would increase their teaching productivity and effectiveness. In a similar manner,

teachers' sense of control over their own choices related to the use of MBA and teachers' feelings connected with classmates or colleagues influence positively their beliefs toward MBA in terms of PU and PEU. Accordingly, since teachers' higher confidence, powerful sense of control and good feelings connected with classmates or colleagues can affect their teaching effectiveness, motivation of teachers should be given importance in order to ensure maximum efficiency in the education and training process. The pioneers of the field (e.g. Deci et al., 1989; Williams et al., 1996) also stated that intrinsic motivation contributes to higher success. These findings occur to contribute to filling the theoretical gap by emphasizing the positive influence of constructs of SDT on PU and PEU, which are consistent with some of earlier studies (e.g. Fathali & Okada, 2018; Luo et al., 2021; Tsai et al., 2021) and differs from a vast majority of previous study results (e.g. Lu et al., 2019; Racero et al., 2020; Rosli & Saleh, 2022; Sørebo et al., 2009). Among the contradicting the results, Sørebo et al. (2009) who conducted one of the first studies in this field, for example, found that relationships between PA and PU and PR and PU were not significant. In other words, teachers' desire to self-regulate their actions while using technology and the beliefs that important teachers are connected and encouraged don't reflect how they presume that using a specific system will improve job efficiency. In a recent study, Racero et al. (2020) found that there is no significant relationship between PC and PU, and PEU. Overall, although there are different studies that contradict and support the current study, the conceptual model confirmed the applicability of SDT in explaining teachers' beliefs about MBA with regards to easiness and usefulness.

Findings related to TAM supported hypotheses from H7 to H11 and showed that PEU had an influence on PU and attitude, PU was significantly related to attitude and intention. In addition, PU and perceived ease accounted for 38% of the variance in attitude toward the use of MBA in courses. This finding contributes to the theoretical framework by approving that the relationship constructs engaged in TAM. It showed that the ease of use and usefulness of MBA contributes to generating teachers' favourable perceptions and intentions to use this technology. These results are consistent with the studies of Nikou and Economides (2017a, 2017b, 2019) who found that when the MBA is perceived as easy and useful, people are willing to use it. Among the constructs of TBP (H12 and H13), SN and PBC were reported to have a significant positive influence on intention which supported the results of Sánchez-Prieto et al. (2019) and Teo et al. (2016) who highlighted the role of social pressure to use mobile technologies in teachers' practice and the importance of perceived ease or difficulty of the behaviour in making decisions. That is, as far as theoretical implications are concerned, intentions to use MBA become more powerful when salient referents (i.e. teachers, school administrators, and students' parents) support activities, and perceived external obstacles and personal inadequacies don't impair the ability to use MBA.

Perceived usefulness, perceived ease of use, and attitude were found as significant mediators to explain in-service and pre-service teachers' usage intentions in context of online learning environments (i.e. mobile-based assessment). In addition, the importance of these constructs that links the SDT, TPB and the TAM provided important theoretical value to the present study. These results are parallel to some of earlier studies that merged theories/models and proposed conceptual models and tested the mediating effect in e-learning context (e.g. Chahal & Rani, 2022; Hsu & Lin, 2022; Şimşek & Ateş, 2022). Recently, Fussell and Truong (2022) extended the TAM model that incorporated constructs from TPB and proposed a new conceptual model in the context of virtual reality in the dynamic learning environment. The results showed that perceived usefulness, perceived ease of use, perceived enjoyment, and perceived behaviour control were significantly indirectly related to intention to use virtual reality for dynamic learning. Considering the mediating roles of these constructs, the findings demonstrated that it is effective to utilize these variables as mediators when extending/deepening a present model and proposing a new model. Findings toward moderator analysis showed that gender is an important factor in educational technology and implies that females are more relevant to mobile learning technology. This finding is consistent with some of the earlier findings studied with teachers (e.g. Baek et al., 2017; Habibi et al., 2022; Prieto et al., 2017), while it was contrary to some of the previous teacher-oriented studies (e.g. Abu-Taieh

et al., 2022; Li et al., 2016; Sang et al., 2010; Teo & Milutinovic, 2015; Walker et al., 2020). However, no significant difference was obtained with regard to sample type. Considering in-service teachers are older than pre-service teachers, results of the current study indicated that, age factor did not show any significant difference between in-service and pre-service teachers. While these results were consistent with some previous research results (e.g. Nikolopoulou et al., 2021), some showed contradictory results (e.g. Venkatesh et al., 2012). Considering the studies on gender and age differences, it was revealed that studies on gender and age differences have been conducted globally, in diverse regions such as China, Greece, Indonesia, Iraq, Korea, Serbia, Singapore, Spain, the USA, and Turkey, showcasing the influence of Eastern and Western cultures. Cultural differences play a crucial role in shaping individuals' beliefs, attitudes, and behaviours, and thus can significantly impact the results of studies conducted in different regions. The varying results between studies, therefore, could be attributed, in part, to cultural differences, making it an essential aspect to consider while interpreting and understanding the results. In a rapidly globalizing world, where technology is breaking down geographical barriers, it is imperative to consider the cultural context in which studies are conducted. Doing so will help us to gain a more nuanced and comprehensive understanding of the results, and to develop more culturally sensitive and inclusive theories, models, and interventions. By acknowledging the role of cultural differences, we can gain a deeper understanding of the relationships between gender, age, and technology use, and develop more effective and sustainable solutions to address the challenges posed by the rapidly changing technological landscape.

From a practical point of view, results of the study present several implications for policymakers, teacher educators, and school administrators. First, the study indicated that teachers' positive perceptions of using MBA can improve their willingness to use this technology in their courses. School administrators should look for solutions to help teachers improve their positive perceptions about MBA, such as providing technology-supported classes, financial support, and R&D projects. Second, the study emphasized the importance of perceived usefulness, perceived ease of use, and attitude in forming teachers' intentions to use MBA. Policymakers, researchers, and administrators should focus on improving these mediator variables to drive teachers' intentions towards using MBA. Third, school administrators can support teachers in integrating mobile technology into the classroom by providing the necessary conditions for the mobile technology-driven teaching-learning process. This may include providing access to technology and training programmes for teachers. Fourth, the study highlighted the moderating impact of gender on intention to use MBA, suggesting that targeted programmes may need to be developed to address any gender-based differences. Finally, the finding that there is no difference between pre-service and in-service teachers in terms of their intentions to use MBA highlights the importance of promoting technology-enhanced education for both groups. This can inform the development of targeted teacher training programmes, equitable access to technology, and informed curriculum development to support the integration of MBA into the classroom.

## **5.2. Limitation and future studies**

The study has various limitations that should be considered in future research. Firstly, the data were collected from a convenience sample of pre-service and in-service teachers from several universities and middle schools located in cities with similar characteristics in Turkey. As a result, the sample population may not be representative of the larger population of teachers, and the results may not generalize to individuals with different cultural or professional backgrounds. To overcome this limitation, future studies could consider using a more comprehensive research design with a larger, more diverse sample group to increase external validity and decrease sampling limitations. Secondly, the data were collected through self-reported measures, which can be influenced by social desirability bias. Participants may have responded in a way that they believed was expected of them, rather than providing an accurate reflection of their actual experiences and beliefs. To

address this limitation, future studies could consider incorporating more objective measures, such as observation or performance-based assessments, to validate the findings and increase the reliability of the results. Thirdly, the results of the study are limited by the time frame in which the data was collected. It is possible that the use of MBA in education has evolved or changed since the time of data collection, leading to a potential bias in the results. Finally, the study did not consider the specific types of MBA used in education and their relative effectiveness, which could lead to limitations in the generalization of results to different types of MBA. Considering the results of the present study, the following suggestions can also be made:

- The present study is interested in intention to use MBA instead of actual behaviour since majority of the participants are undergraduates and therefore they don't have teaching experience at schools. Even though intention is the best determinant of behaviour (Ajzen, 1991), it is not the same and may not completely reflect actual behaviour (Pomery et al., 2009). Hence, future researchers should examine determinants of the actual use of MBA in classes.
- The study focused on only pre-service and in-service teachers' intentions. Thus, it is suggested that future studies can focus on students' readiness with regard to the use of MBA.
- This study was carried out based on quantitative research methods only. It is suggested that future studies can use mixed methods to examine the results more in-depth.
- The study showed the positive effect of predictors within the proposed model on pre-service and in-service teachers' intentions to use MBA. Therefore, it is suggested that MBA technology should take place in the educational environment at elementary schools and universities.
- MBA systems should be easy to use and useful in order to ensure that in-service teachers and pre-service teachers develop their attitudes towards MBA in a positive way.
- By making a long-term study, pre-service teachers' use of mobile technology in their assessing process can be followed.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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