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A SYSTEMATIC REVIEW OF MOBILE-BASED ASSESSMENT ACCEPTANCE STUDIES FROM 2009 TO 2019

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ABSTRACT

Despite many studies being conducted on mobile learning acceptance, few investigate mobile-based assessment acceptance. The objectives of this study are: (1) to provide valuable insights into current research on mobile-based assessment literature and (2) to identify the main gaps in the mobile-based assessment acceptance literature. Therefore, the present study systematically reviews 45 previous studies and eight articles related to mobile-based assessment acceptance to provide a comprehensive analysis of the articles published from 2009 to 2019. Findings indicate that majority of mobile-based assessment studies focused on evaluating the effectiveness and performance of mobile-based assessment system and conducted at the secondary school level. In addition, this study identified several gaps. Further research is needed to study the acceptance problem of a mobile-based assessment system. More investigation is required to predict which external factors that can enhance the acceptance and use of mobile-based assessment among students. The findings of this review study provide a valuable reference for researchers about the current trend of mobile-based assessment research as well as the research gaps that should be covered in future studies.

Keywords: *Mobile-Based Assessment; Acceptance studies; Systematic Review.*

1. INTRODUCTION

Because of the advances in mobile device features, mobile learning is increasingly being used as a new tool for learning and education [7,9, and 11]. Researchers have provided evidence that mobile learning has many benefits for education such as learning anywhere and anytime, accessibility, and interactivity [8];[14];[73]. These benefits have motivated many universities to adopt mobile devices as an informal assessment tool known as "Mobile-Based Assessment (MBA)". According to [42], the MBA has become another delivery tool for assessments that are used to complement paper and computer-based testing. Nikou and Economides [56] defined MBA as a new mode of assessment based on the use of mobile and wireless technologies. MBA provides useful functionality and the opportunity to assess learning differently than through paper or computer-based assessments [57]. MBA is flexible because it allows for assessment both inside and outside the classroom[50]. , and provides immediate and personalised feedback [61].

However, despite the important and exciting benefits that provide by MBA, the use and acceptance of MBA is a contested issue in the literature that still needs further investigation[16];[58]. Many researchers focused on their studies on studying the acceptance of mobile learning in higher education [10]; [2], the use of mobile information system services in universities environment [12] and adoption of mobile technologies [1];[62]. Few studies have investigated the use and acceptance of Mobile-Based Assessment. The ones that did examine the acceptance of MBA ignored some critical issues that may enhance the acceptance of MBA such as enjoyment, learning content and usability. Moreover, none of the studies provides a comprehensive review of the current status of research related to MBA.

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This study is essential for two reasons; the first is that previous research indicated the determinants of MBA acceptance are still not clear. Identifying these determinants is one of the most critical issues in the success of any new system [56]. Second, there is a gap in the literature regarding the acceptance of MBA. The current study addresses this gap by providing a systematic review and synthesis of the studies related to MBA acceptance. Understanding the factors that influence the acceptance of MBA in the collected studies will assist the MBA scholars to plan forward to investigate the impact of other factors that are missing in existing literature. The objective of this study is achieved by addressing the following research questions:

RQ1: In the selected studies on MBA, What are the main research purposes?

RQ2: Regarding the second research question, a systematic review of the studies related to acceptance, adoption or intention to use of MBA was carried out. Specifically, this review addressed the following research questions:

RQ2a, In the selected studies of MBA acceptance, What are the main factors that have been studied?

RQ2b, In the selected studies of MBA acceptance, What are the main models and theories of technology acceptance that were used?

RQ2c In the selected studies of MBA acceptance, What are the main research design and method?

Q2d, In the selected studies of MBA acceptance, What are the primary disciplines/contexts and assessment types?

Q2e, In the selected studies of MBA acceptance, What are the primary educational levels and learning domain?

Q2f, In the selected studies of MBA acceptance, What are the years of publication?

Q2g, In the selected studies of MBA acceptance, What are the active countries in the context?

2. RESEARCH BACKGROUND

There are several previous reviews conducted on mobile learning that focused on the acceptance of mobile learning among students as a prior step to the success of mobile learning applications [26];[78]). Also, there are many studies focused on mobile learning in higher education [13]; [63]), the use of mobile learning in specific learning domains such as science and engineering [78]. Most of these studies confirm that mobile learning is a useful and promising tool for supporting students' learning and improving their learning achievements and performance.

Although several studies (e.g., [57]; [60]. investigated mobile-based assessment acceptance in a mobile learning context, mobile-based assessment acceptance among students should also be studied in its context. The previous reviews provided an important research synthesis on mobile learning acceptance literature. None of the previous studies offers a comprehensive review of the current status of research on mobile-based assessment acceptance. This study is the first study to provide a detailed analysis of the literature review about mobile-based assessment acceptance.

3. RESEARCH METHOD

In this study, distinct steps were taken to conduct a rigorous systematic review of the literature related to mobile-based assessment acceptance. The review process was performed based on existing guidelines established by (Kitchenham & Charters[45], which includes (1) identifying the inclusion and exclusion criteria (2) determining the data sources and search strategies and (3) data analysis and coding. This review is considered an essential step before conducting any research paper, and it helps to build the foundation for knowledge accumulation. It also helps to identify the areas that previous studies have missed [49]. The following subsections describe in detail the steps used for conducting the systematic review in this study.

3.1 Identifying The Inclusion And Exclusion Criteria

In the first step of review, a collection of inclusion and exclusion criteria were determined that were used during the selection of articles. Table 1 shows the inclusion and exclusion criteria for mobile-based assessment acceptance.

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Table 1: Inclusion and exclusion criteria in the research process

Inclusion criteria	Exclusion criteria
1. The selected studies that include mobile based assessment acceptance 2. The selected studies that include technology acceptance models 3. The selected studies that involve learning and teaching 4. Must have been published between 2010 to 2018 5. Must be written in English	1. Exclude each study which does not use technology acceptance models in mobile-based assessment 2. Exclude studies in mobile-based assessment development 3. Exclude each study, not in the context of learning and teaching

3.2 Determining The Data Sources And Search Strategies

In the second step of systematic literature review, we collected a large number of studies through a search in the following popular databases: Google Scholar, Wiley, IEEE, ScienceDirect and Springer. The main keywords that were used in the search process are: ("Technology Acceptance Models" AND "Mobile Based Assessment Acceptance". We found through the search process 1033 articles using the keywords above and classified based on the identified databases as shown in Table 2. Then, we excluded all the items that we found as duplicated, which was 200 articles; thus, the total number of the collected items was reduced to 833. After that, the remaining articles were filtered based on the criteria in Table 2. Finally, 54 items met the inclusion criteria and are used in the analysis process. Figure 1 illustrates the systematic review process for this study.

DATAANALYSIS AND CODING

In this research, the following characteristics were investigated and coded including (RQ1) research purpose (with the focus on the mobile-based assessment),

(RQ2) with an emphasis on the mobile-based assessment acceptance, adoption or intention to use interns (RQ2a) external factors, (RQ2b) the impact of external factors, (RQ2c) Technology acceptance models used, (RQ2d) research method (questionnaires, interviews or mixed), (RQ2e) research contexts (e.g., IT and computer science, education, engineering, etc.), (RQ2f) educational levels (e.g., higher education, secondary school, etc.), (RQ2g) publications of year, (RQ2h) country. In the analysis process, the authors focused on the articles that studied the acceptance process of mobile-based assessment based on the technology acceptance models like the TAM and UTAUT.

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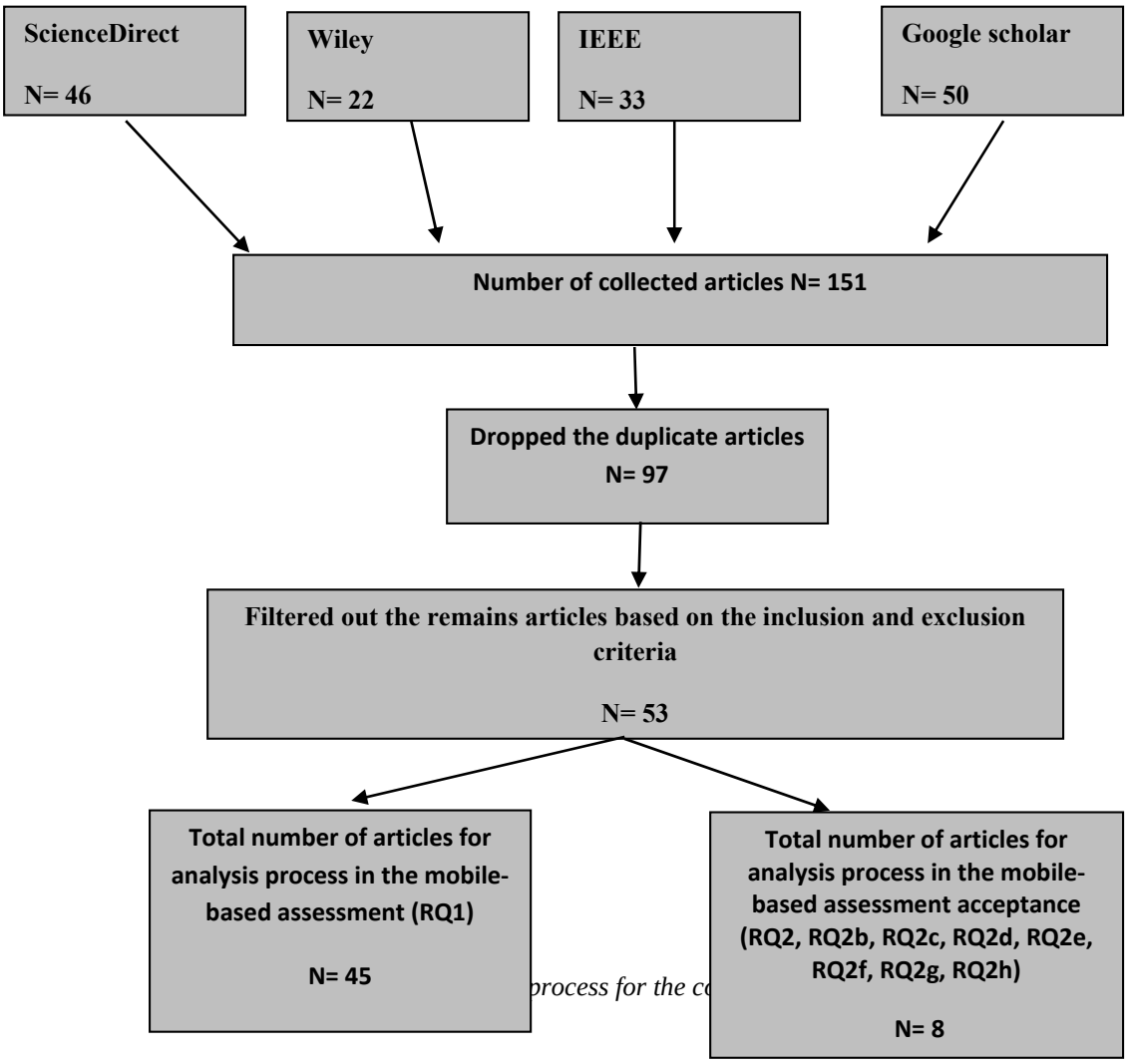

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Table 2: *The distribution of articles collected from the top-ranked databases*

Database	Frequency
ScienceDirect	46
Wiley	22
IEEE	33
Google scholar	50
Total	**151**

RESULTS AND DISCUSSIONS

Based on Table 3, 54 research articles published on the context of mobile-based assessment from 2009 to the end of 2018. In the next section, the findings of the reviewed articles are organised according to the first research question (RQ1).

Table 3: *Mobile-based assessment papers from 2009-2019*

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No	study	Purpose of the study	Result
1.	Al-Emran, & Salloum. (2016) [2]	To investigate the students' attitudes towards the utilisation of mobile technologies in the e-Evaluation system of instructors.	MBA has a positive impact on students' attitudes
2.	Alioon and Delialioğlu (2017) [3]	To investigate the effect of the instructional method and authentic activities on students' engagement and motivation. The evaluation was based on a mobile formative assessment	MBA has a positive impact on students' motivation and attitudes toward learning.
3.	Bogdanović et al. (2014) [15]	To investigate the students' habits, motivations and technical possibilities to incorporate mobile-learning activities in the e-learning process. The evaluation delivered summative assessment activities based on Moodle environment via mobile devices.	Using mobile devices in students learning increases their satisfaction and motivation for learning MBA has a positive impact on student motivation and attitudes, and performance toward learning
4.	Chao et al. (2016) [17]	Use augmented reality (AR) technology to enhance the effect of performance assessment. Development and evaluation of the (MARPAS) A mobile AR performance assessment system	MBA has a positive impact on students' motivation and students' attitudes toward learning
5.	Chen (2010) [18]	To develop a Mobile Assessment Participation System (MAPS) to facilitate the effectiveness of self- and peer-assessment in classrooms. The evaluation was based on PDA devices used as a technology platform.	MBA has a positive impact on students' performance and students' attitudes.
6.	Chen and Chen (2009) [19]	To present formative assessment tools that contain the proposed key learning factor analysis and learning performance assessment rule mining scheme for discovering simplified and key fuzzy learning rules for evaluating the learning performance of learners. Evaluation of a PDA formative assessment system with e-portfolios environment.	MBA has a positive impact on students' performance, student motivation, and students' attitudes.
7.	Chen et al. (2013) [20]	To investigate how to integrate print and digital content with effective technological support effectively. Examines whether the pedagogical strategy of constructive feedback has a significantly positive effect on learning performance in such printed materials. The evaluation was based on smartphone-based formative activities and self- assessment	MBA has a positive impact on students' performance
8.	Chen et al. (2017) [21]	To study how to improve academic achievement by enhancing positive classroom behaviours. Developed classroom behaviour management system (CBMS), the evaluation was tablets based formative assessment	MBA has a positive impact on students' performance toward learning
9.	Chou et al. (2017) [22]	To investigate the effect of the BYOD approach on student learning performance. To reduce classroom management problems,	Most of the BYOD participants expressed positive learning experiences, particularly about their

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No	study	Purpose of the study	Result
		the BYOD approach in the study became a formative assessment tool during class, and an application called Socrative was used with school-authorised smartphones.	motivation and interest levels. MBA has a positive impact on students' performance, student motivation, and students' attitudes.
10.	Chu (2014) [23]	To develop and evaluate a formative assessment mobile learning system.	MBA negatively impacts students' performance.
11.	Chu et al. (2010) [24]	To present a mobile learning system that used radio frequency identification (RFID) technology to detect and examine real-world learning behaviours of students, and evaluation of the effectiveness of MBA in the learning process based on the formative assessment.	MBA has a positive impact on students' performance, student motivation, and students' attitudes.
12.	Coulby et al. (2011) [25]	To examine the impact of delivering competency-based formative assessment via personal digital assistants (PDAs).	MBA has a positive impact on students' performance and attitude.
13.	Dalby and Swan (2018) [27]	To explore the effect of mobile formative assessment in science and mathematics. Evaluation of the effectiveness of iPads to improve learning.	MBA has a positive impact on students' performance.
14.	de-Marcos et al. (2010) [30]	To present a new tool design (web-based system) to reinforce students' knowledge using self-assessment to enable m-learning	MBA has a positive impact on students' performance, students' attitudes, and neutral for students' motivation
15.	Fernández-Alemán et al. (2016) [31]	An empirical study of a formative neural network-based assessment approach by using mobile technology to provide pharmacy students with intelligent diagnostic feedback.	MBA has a positive impact on students' performance and students' attitudes
16.	Fuad et al. (2018) [32]	The design, deployment and evaluation of mobile response system (MRS) software that can facilitate the execution and assessment of multi-step in-class interactive problem-solving activities using mobile devices to enhance the learning.	MBA has a positive impact on students' performance and students' attitudes.
17.	GarcíaLaborda et al. (2014) [33]	To provide a robust and low-cost system for the foreign language paper of the Spanish College Entrance Exam (PAU).	MBA has a positive impact on students' attitudes
18.	Gikas and Grant (2013) [34]	To explore the role of mobile computing devices and the use of social media to examine students' perceptions based on a formative assessment	MBA has a positive impact on students' attitudes
19.	Gu et al. (2011) [35]	The role of lifelong learning to enhance the students' perceptions toward using mobile micro-formative assessment	MBA has a positive impact on students' attitudes
20.	Harchay et al. (2017) [36]	To propose an assessment system built on Semantic web technologies and Web services to support personalised self-assessment in mobile environments.	MBA has a positive impact on students' motivation and students' attitudes,
21.	Harchay, et al. (2015) [37]	To develop an approach based on Semantic web technologies to support personalised self-assessment in mobile environments	MBA has a positive impact on students' performance and students' attitudes
22.	Huang et al. (2009)	The development and implementation of the formative and summative, and self-	MBA has a positive impact on students' attitudes

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No	study	Purpose of the study	Result
	[38]	assessment based on item response theory (IRT) to explore the students' perceptions toward m-learning	
23.	Hung et al. (2013) [39]	The development of a series of worksheets as scaffolding to support inquiry-based ecology observations in a mobile learning environment based on a formative assessment to enhance the learning process	MBA has a positive impact on students' performance, student motivation, and students' attitudes
24.	Hwang and Chang (2011) [40]	To propose a formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students	MBA has a positive impact on students' performance and students' attitudes
25.	Illingworth et al. (2015) [41]	To determine the usage rates, measurement equivalence, and potential outcome differences between mobile and non-mobile device based deliveries of an unproctored, non-cognitive assessment	MBA has a positive impact on students' performance and students' attitudes
26.	Karadeniz, (2009). [43]	To determine the impacts of paper-based, web-based and mobile based assessment on the achievement of the students in the internet assisted instruction	MBA has a positive impact on students' performance and students' attitudes
27.	Karadeniz, S. (2011). [44]	To determine the impact of students' gender and test anxiety on their achievements in the mobile-based assessment	MBA has a positive impact on students' performance
28.	Lai and Hwang (2015) [46]	To propose an interactive peer-assessment criteria development approach to help students develop assessment criteria, learn from viewing peers' work, and make reflections in artwork design activities using mobile devices. To evaluate the effectiveness of m-learning	MBA has a positive impact on students' performance, student motivation, and students' attitudes
29.	Lai et al. (2018) [47]	The development of a self-regulated science inquiry approach to assist students in organising information from their real-world exploration. Based on mobile formative and self-assessment to enhance m-learning	MBA has a positive impact on students' performance, student motivation, and students' attitudes
30.	Looi et al. (2011) [48]	To examine the effectiveness of the enacted mobilised science curriculum based on mobile formative and self-assessment to enhance m-learning.	MBA has a positive impact on students' performance and students' attitudes
31.	Nedungadi and Raman (2012) [51]	To compare e-learning with m-learning based on adaptive learning and formative assessment	MBA has a positive impact on students' attitudes, and neutral for students' performance
32.	Nikou and Economides (2014) [52]	To investigate the technology acceptance model constructs "Attitudes towards Using" (ATU) and "Intention to Use" (ITU) mobile-based assessment from the perspective of the self-determination theory of motivation.	The constructs of SDT have a positive impact on students' attitudes toward usage of MBA
33.	Nikou and Economides (2015) [53]	To examine the impact of perceived mobility, satisfaction, perceived usefulness and perceived ease of use on students' behavioural intention to use MBA.	MBA has a positive impact on students' attitudes.

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No	study	Purpose of the study	Result
34.	Nikou and Economides (2016 b) [54]	To examine the impact of perceived mobility, authentic context and interest/enjoyment of students' perceived usefulness, perceived ease of use and behavioural intention to use MBA.	MBA has a positive impact on students' motivation and students' attitudes.
35.	Nikou and Economides (2016 a) [55]	To investigate the effect of paper, computer, mobile mode of assessment on students' motivation and achievement. The evaluation was based on self-assessment.	MBA has a positive impact on students' performance and students' motivation
36.	Nikou and Economides (2017c) [58]	The study proposes MBAMF, a Mobile-Based Assessment Motivational Framework based on the Self-Determination Theory (SDT) of Motivation. The framework aims to connect the basic SDT constructs with features offered by mobile-based assessment	MBA has a positive impact on students' performance
37.	Nikou and Economides (2017a) [56]	To predict students' intentions to use mobile-based assessment based on constructs of the TAM and SDT. The evaluation was based on self-assessment	MBA has a positive impact on students' motivation toward learning
38.	Nikou and Economides (2017b) [57]	To provide empirical evidence on the acceptance of MBA among students based on the TAM model. The evaluation used formative and summative assessment	MBA has a positive impact on students' attitudes
39.	Nikou and Economides (2018a) [61]	To propose a series of Mobile-Based micro-Learning and Assessment (MBmLA) homework activities to improve high school students' motivation and learning performance in science. Based on formative and self-assessment	MBA has a positive impact on students' attitudes, and neutral for students' performance
40.	Nikou and Economides (2018b) [59]	To explore science, technology, engineering, and mathematics (STEM) teachers' intention to use mobile based assessments in practice	MBA has a positive impact on STEM teachers' attitudes
41.	Pu et al. (2016) [64]	To propose an authentic learning model for vocational nursing education via mobile formative and self-assessment	MBA has a positive impact on students' attitudes
42.	Roschelle et al. (2010) [65]	To compare group and individual feedback using two technologies: a handheld device and a desktop device. The evaluation was based on formative assessment	MBA has a positive impact on students' performance
43.	Samaie et al. (2018) [66]	To explore the efficiency of WhatsApp for self and peered assessment in English learning to evaluate students' performance and attitudes	MBA has a positive impact on students' performance, negative for students' attitudes
44.	Santos et al. (2011) [68]	To propose an approach for "assessment in situ" activities, where questions are answered in front of a real space/location (situ), students can answer the tests using mobile devices with GPS. The system was evaluated based on formative assessment	MBA has a positive impact on students' performance, students' motivation, and students' attitudes
45.	Santos et al. (2012) [67]	To propose a conceptual model of three main dimensions(the question-item, the test and the activity to be considered for advancing	MBA has a positive impact on students' motivation

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No	study	Purpose of the study	Result
		on Computing-Based Testing (CBT). The model was evaluated by using mobile formative assessment	
46.	So (2016) [69]	To evaluate the use of mobile instant messaging tools to support teaching and learning in higher education. Based on the formative assessment	MBA has a positive impact on students' attitudes, and students' performance
47.	Song and Kong (2017) [70]	To examine the affordances and constraints of BYOD (Bring Your Own Device) for varied pedagogical practices from teachers' perspectives in higher education. The evaluation was based on various types of assessment	MBA has a positive impact on teachers' attitudes, and students' performance
48.	Stowell (2015) [71]	To compare the number of correct, incorrect, and missing responses of students who responded to in-class polling questions using clickers or mobile devices	MBA has a positive impact on student' attitudes and neutral effect of MBA on students' performance
49.	Sun (2014) [72]	To assess the differences between the effects of clickers and mobile polling, The study utilised a quasi-experimental research design based on classroom polling	MBA has a positive impact on students' performance,
50.	Tarighat and Khodabakhsh (2016) [74]	To investigate the feasibility of Mobile-Assisted Language Assessment (MALA) as well as the learners' attitudes to such phenomenon by using electronic portfolios and a social networking application (WhatsApp) on smartphones.	Mixed attitudes towards MALA. Regarding the learners; the concerns were mainly regarding fairness and lack of authentic communication.
51.	van der Schaaf et al. (2017) [75]	Advocates that E-portfolios enhanced with learning analytics might increase the quality and efficiency of workplace-based feedback and formative assessment in professional education	MBA has a positive impact on students' attitudes
52.	Wang (2015) [76]	To evaluate the wear out the effect of the Kahoot! game-based student response system. The evaluation was based on polling assessment.	MBA has a positive impact on students' motivations and students' attitudes.
53.	Zhai et al. (2016) [77]	To examine how high school students used mobile devices in physics classrooms and after school, and the impact of in-class and after-school mobile technology use on their physics learning performance and interest.	MBA has a positive impact on students' performance and students' attitudes.

RQ1: Based on the reviewed articles of MBA, What are the main research purposes?

In the first question, the reviewed article is classified in terms of the research purpose. Based on that, each of the 54 articles was classified into three categories as follows: (1) acceptance, adoption or intention to use of MBA, (2) development and design MBA system and (3) evaluation of the effectiveness and performance of MBA systems. Figure 1 indicates that most reviewed studies (53 articles) focused on evaluating the effectiveness and performance of mobile-based assessment system (81%), four articles (6%) develop and design MBA system and only eight articles (13%) acceptance, adoption or intention to use of MBA.

A recent study conducted by Nikou and Economides [60] also reported that most research reviews of mobile-based assessment focused on evaluating the effectiveness and performance of

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MBA, followed by the development and design of MBA. Few studies focused on acceptance, adoption or intention to use MBA. The lack of research on acceptance, adoption, and intention is considered a new finding that is not raised in previous literature. Therefore, this study recommends conducting more studies to investigate this issue further

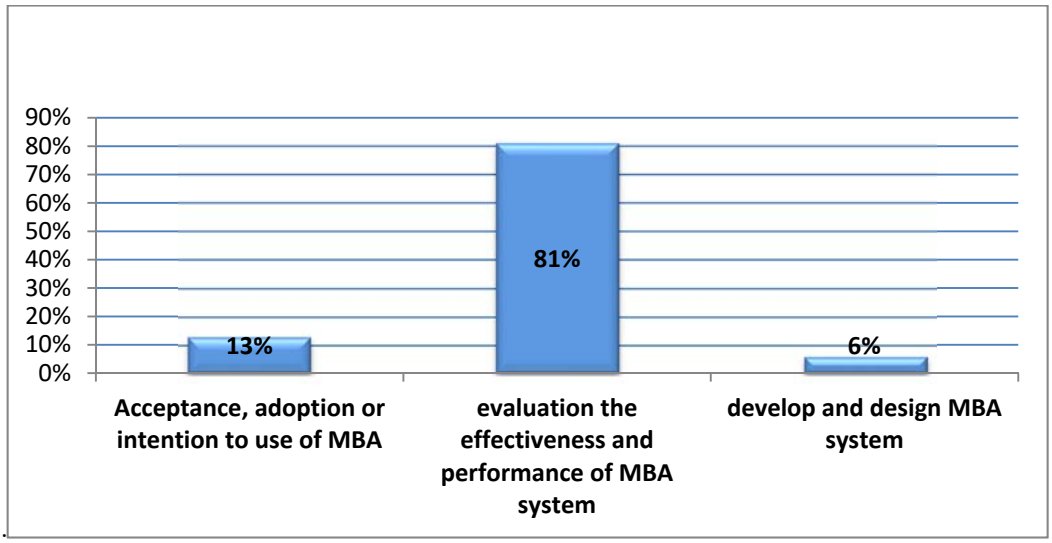

Figure 2: *Distribution of articles based on research purpose.*

RQ2: Regarding the second research question, the systematic review was focused on the studies related to acceptance, adoption or intention to use MBA.

For the second research question, the focus is on the articles related to acceptance, adoption or intention to use of mobile-based assessment. Table 4 shows the studies in the context of mobile-based assessment acceptance, adoption or intention to use that were extracted from Table 3. The main research purposes in these studies were to study the acceptance, adoption of mobile-based assessment among students and to investigate the main factors that affect the usage and acceptance of mobile-based assessment in the higher education context. A brief description of

each study is provided.

Table 4 shows research articles published on the context of mobile-based assessment acceptance, adoption or intention to use from 2009 to the end of 2018. In the next sub-sections, the findings of the reviewed articles were organised according to the seven sub-research questions (RQ2a, RQ2b, RQ2c, RQ2d, RQ2e, RQ2f, RQ2g, RQ2h,).

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No	study	Aim	subject	Country	Learning domain	Research design	Model acceptance	Course	independent factors	Result
1	Nikou and Economides (2014) [52]	To investigate the effect of STD construct on students' intention to use MBA	72 Participants	Greece	Clinical practice /higher education	Quantitative	TAM and SDT	. medical work-based environments	Autonomy(AUT), Relatedness (REL) and Competency(COM)	SDL construct have positive impact on students' to use MBA
2	Nikou and Economides (2015) [53]	To investigate the effect of mobility and satisfaction on students' intention to use MBA	47 Participants	Greece	Secondary stage	Quantitative	TAM	environmental education.	Mobility ,and satisfaction	Mobility, and satisfaction have positive impact on students' intention to use MBA
3	Nikou and Economides (2016 b) [54]	To examine the effect of mobility, authentic, and Enjoyment on students' intention to use MBA	50 Participants	Greece	Secondary stage	Quantitative	TAM	environmental course about biodiversity Positive impact on student motivation	Mobility; Authentic, Enjoyment	mobility, authentic, and Enjoyment have positive impact on students' intention to use MBA
4	Nikou and Economides (2017a) [56]		145 Participants	European senior-level	Secondary stage	quantitative	TAM	environmental course about biodiversity	Perceived Ubiquity Value , Mobile Self-Efficacy, Content, feedback, Perceived Interactivity, Perceived Collaboration	there is a relation between motivation and technology Acceptance. Students are willing to use the system if the system satisfy Autonomy(AUT), Relatedness(REL) and Competency(COM)
5	Nikou and Economides (2017b) [57]	to identify factors that affect secondary students' acceptance of mobile-based assessment	145 Participants	European	Secondary stage	Quantitative	TAM	environmental project about biodiversity	the constructs of Facilitating Conditions, Social Influence, Mobile Device Anxiety, Personal Innovativeness, Mobile-Self-Efficacy, Perceived Trust, Content, Cognitive Feedback, User Interface and Perceived Ubiquity	The study found that students' behavioral intention to adopt mobile-based assessment depends on a combination of environmental, educational, user profile and mobile device factors.

									Value and investigates	
6	Nikou and Economides (2017c) [58]	To investigate the factors that satisfy SDL construct : Autonomy, Relatedness and Competency in MBA environment	47 Participants	Greece	Higher education	Quantitative	SDT	medical work-based environments	meaningful choice, reduce anxiety, contextualized support, feedback, authenticity, guidance, communication, collaboration	Meaningful choice, reduce anxiety, contextualized support, feedback, authenticity, guidance, communication, and collaboration have satisfy the SDL constructs
7	Nikou and Economides (2018a)[61]	To investigate the impact of Micro-learning activities on students' performance ,and motivation	108 Participants .	Europe	Secondary stage	Quantitative	SDT	Physic course	Mobile based-Micro-learning activities (small pace of learning activity)	Mobile based-Micro-learning activities has positive impact on student motivation
8	Nikou and Economides (2018b) [59]	This study explores science technology engineering and mathematics (STEM) teachers' intention to use mobile based assessments in the teaching practice	161 Participants	Europe	STEM teachers in schools	Quantitative	TAM	Science technology engineering and mathematics (STEM	SI, social influence; FC, facilitating conditions; OQ, output quality; MSE, mobile self-efficacy.	The study findings revealed that focusing on mobile assessment quality design as well as on institutional support are important factors for STEM teachers in order to accept mobile-based assessments in schools

Table 4: Analysis Of The Articles Of Mobile-Based Assessment Acceptan

RQ2a: In the selected studies of MBA acceptance, What are the main factors that have been studied in the context of mobile-based assessment acceptance, adoption or intention to use?

RQ2b: What is the impact of external factors on mobile-based assessment acceptance of each study?

This section presents the literature and studies conducted to study the factors that impact a student's acceptance of MBA. As showed in Table 4, only eight studies were conducted in the field of acceptance, adoption or intention to use of mobile-based assessment.

Nikou and Economides [52] conducted a study to investigate the effect of motivation factors (autonomy, relatedness and competency) on students' acceptance of mobile-based assessment. They found the autonomy, relatedness and competency are the main factors for improving adoption of mobile-based assessment among students. Also, Nikou and Economides [53]studied the impact of mobility and satisfaction on students' intention to use mobile-based assessment. Nikou and Economides [54]studied the acceptance of mobile-based assessment by students through investigating the effect of mobility, authenticity, and enjoyment. Nikou and Economides [57] investigated the influence of perceived ubiquity value, mobile self-efficacy, content, perceived interactivity, perceived collaboration on students' intention to

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use of mobile-based assessment. They performed a study to identify factors that influence secondary school students` acceptance of mobile-based assessment. They found that the constructs of facilitating conditions, social influence, mobile device anxiety, personal innovativeness, mobile-self-efficacy, perceived trust, content, cognitive feedback, user interface and perceived ubiquity value have a positive impact on students' intention to use mobile-based assessment. Nikou and Economides [58] investigated the effect of 11 factors (meaningful choice, reduce anxiety, contextualised support, feedback, authenticity, guidance, communication, collaboration, autonomy, relatedness and competency) on acceptance of mobile-based assessment by students. In a recent study, Nikou and Economides [61]studied the effect of social influence, facilitating conditions, output quality, mobile self-efficacy on students' intention to use mobile-based assessment.

Figure 4 presents the distribution of reviewed studies in terms of the impact of external factors on acceptance of mobile-based assessment. The proposed factors were classified according to their effect on mobile-based assessment acceptance into three levels (positive impact, negative impact and not specified). As illustrated in Figure 4, 98% of the external factors had a positive effect on students' acceptance of mobile-based assessment, while 2% had a negative impact.

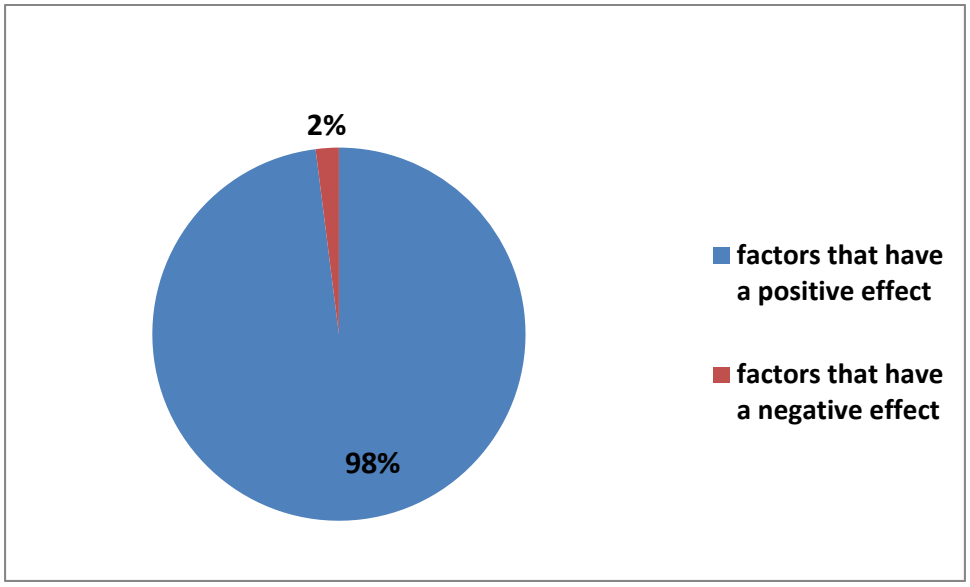

Figure 3: *Impact of external factors on mobile-based assessment acceptance.*

In the reviewed articles, mobile-based assessment acceptance has mainly been studied by examining external factors like (autonomy, relatedness, competency, mobility, satisfaction, perceived ubiquity value, mobile self-efficacy, content, perceived interactivity, perceived collaboration). Other critical areas were ignored like technological factors, enjoyment factors, system quality factors, and cultural factors. Therefore, it would be interesting to focus on these factors in future studies of mobile-based assessment acceptance.

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Table 5: Analysis Of The Impact Of External Factors On Mobile-Based Assessment Acceptance.

No	Study	Factors	Impact of each factor on mobile-based assessment acceptance		
			Positive	Negative	Not Specified
1	Nikou and Economides (2014a)	Autonomy	√		
		Relatedness	√		
		Competency	√		
2	Nikou and Economides (2015)	Mobility	√		
		Satisfaction	√		
3	Nikou and Economides (2016)	Mobility	√		
		Authentic	√		
		Enjoyment	√		
4	Nikou and Economides (2017a)	Perceived ubiquity value	√		
		Mobile self-efficacy	√		
		Content	√		
		Perceived interactivity	√		
		Perceived collaboration	√		
5	Nikou and Economides (2017b)	Facilitating conditions	√		
		Social influence	√		
		Mobile device anxiety		√	
		personal innovativeness	√		
		Mobile-self-efficacy	√		
		Perceived trust	√		
		Content	√		
		Cognitive feedback	√		
		User interface	√		
		Perceived ubiquity value	√		
6	Nikou and Economides (2017c)	Meaningful choice	√		
		anxiety		√	
		Contextualised support	√		
		Feedback	√		
		Authenticity	√		
		Guidance	√		
		communication	√		
		Collaboration	√		
		Autonomy	√		
		Relatedness	√		
		Competency	√		
7	Nikou and Economides (2018)	Social influence	√		
		Facilitating conditions	√		
		Output quality	√		
		Mobile self- efficacy	√		

RQ2c: In the selected studies of MBA acceptance, What are the main models and theories of technology acceptance that were used?

Concerning the research question about the technology acceptance models and theories to predict the significant factors that lead to MBA acceptance. Figure 4 shows that most of the reviewed papers (71%) used the technology

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acceptance model (TAM) [28] by adding external factors to examine them with mobile-based assessment acceptance. 25% of the articles extended the self-determination theory SDT [29] to investigate the impact of motivation factors on acceptance of mobile-based assessment. The rest of the reviewed articles (14%) investigated the mobile-based evaluation acceptance by integrating two models.

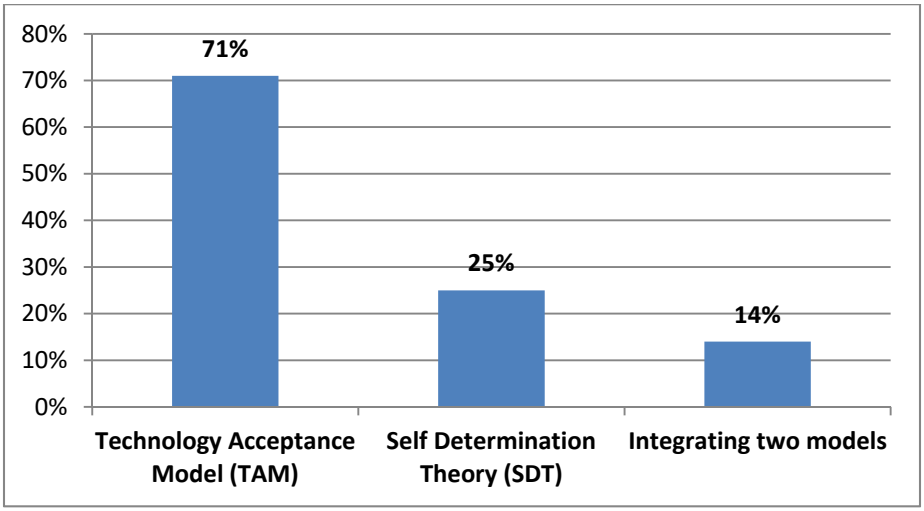

Figure 4: *Analysis of the used Technology Acceptance Models in mobile-based assessment acceptance studies*

In the reviewed articles, the majority (e.g., [53]; [54];[56] focused on extending the TAM model. None predicts the acceptance of mobile-based assessment based on other models of technology acceptance like the unified theory of acceptance and use of technology (UTAUT), innovation diffusion theory (IDT), and the DeLone and McLean information system success model (DL&ML)". Therefore, more research is needed mobile-based assessment acceptance that incorporates technology acceptance models like the UTAUT, IDT and DL&ML.

RQ2d: In the selected studies of MBA acceptance, What are the main research design and method?

Concerning the research question related to research design and methods, Table 5 illustrates that 100% of MBA studies used quantitative data collection through a questionnaire or survey. This result is consistent with the previous reviews conducted by [26] who reported that questionnaires were the primary method for data collection in mobile learning acceptance studies. They also stated that it is the best method to determine the relationship between the factors in the conceptual model. However, the questionnaire method is not always appropriate for all studies, and future research needs to employ other data collection methods like interviews and the Delphi technique. These methods could provide a deeper insight into the factors that influence mobile-based assessment from a student's perspective, as well as from experts in the field of mobile learning and mobile-based assessment.

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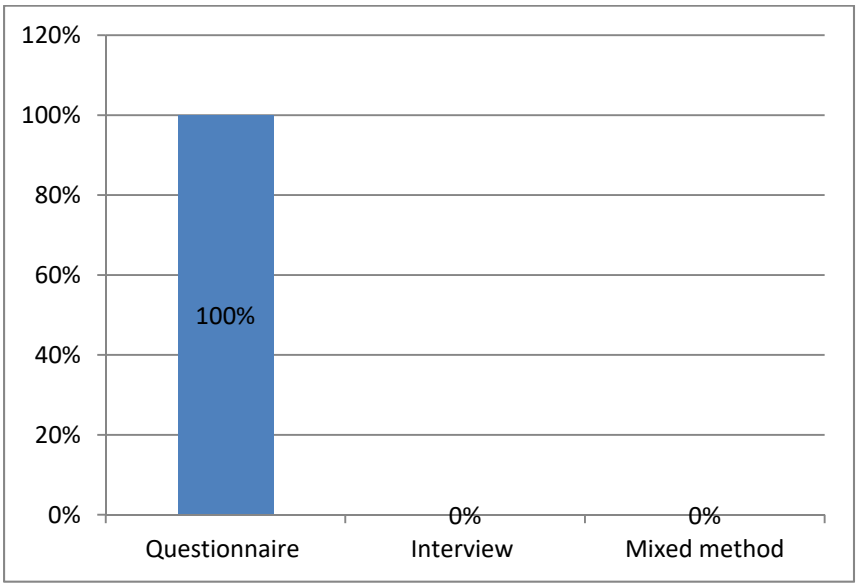

Figure 5: *Analysis of the mobile-based assessment acceptance studies in terms of research methods used*

RQ2e: In the selected studies of MBA acceptance, What are the main disciplines/contexts?

In terms of the research context, the reviewed articles were categorised based on the context of the study. Figure 6 shows that the majority of mobile-based assessment acceptance research (37%) was applied in a biology science context. 25% of the studies were conducted in a medical, scientific, technology, engineering, or mathematics context, and finally, 13% were related to education.

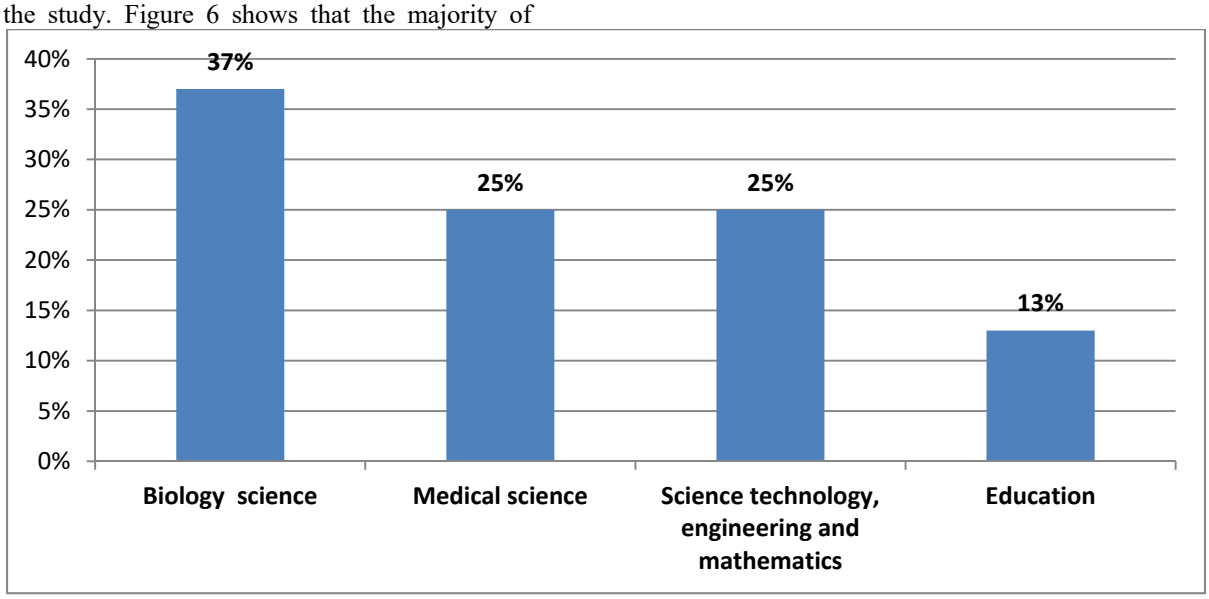

Figure 6: *Distribution of mobile-based assessment acceptance studies based on contexts/disciplines.*

The majority of mobile-based assessment acceptance studies were conducted in a scientific context (e.g. biology, medical, science technology, engineering and mathematics). Few have been performed in the social, humanities and educational sciences contexts. Therefore, more investigation is recommended in these areas.

RQ2f: In the selected studies of MBA acceptance, What are the main educational levels and learning domains?

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For the research question related to educational levels and learning domain, the studies were categorised into two levels, secondary school or higher education level. Figure 7 shows the majority of reviewed articles (6 studies) were conducted at a secondary school level to study the acceptance of MBA, while two studies focused on university students.

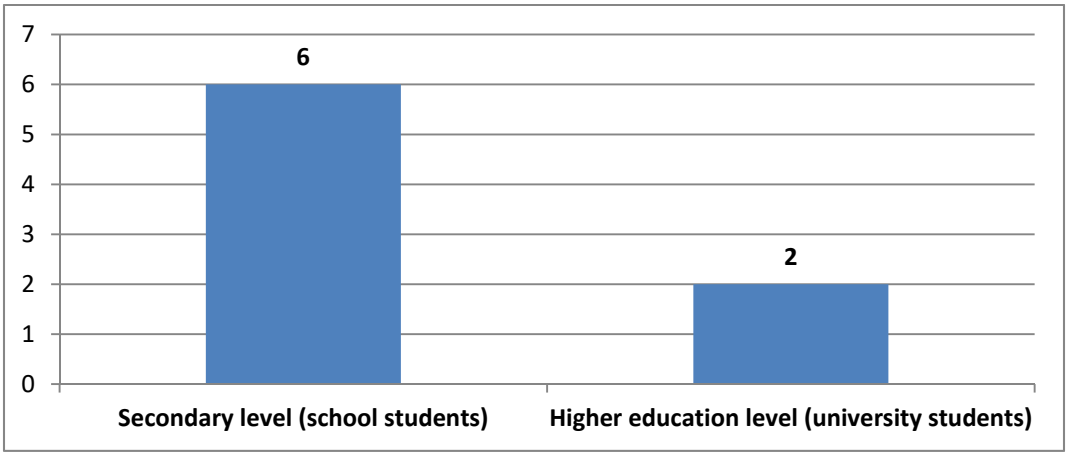

Figure 7: *Distribution of mobile-based assessment acceptance studies based on educational levels.*

Based on the analysis of the articles in Figure 7, it is interesting to note that only two studies were conducted in a higher education context. Based on this, further research is needed to investigate the key factors that effect on mobile-based assessment acceptance among university students.

RQ2g: In the selected studies of MBA acceptance, What are the years of publication?

For the question related to years of publication, Figure 8 shows that the number of studies conducted in 2014, 2015 and 2016 was one per year. In 2017, there was an increase in the number of articles related to MBA acceptance (3 studies), also in 2018 (2 studies). This increase in the last two years (2017 and 2018) is attributed to the increased popularity of mobile apps and the increased use of smartphones and tablets for educational purposes.

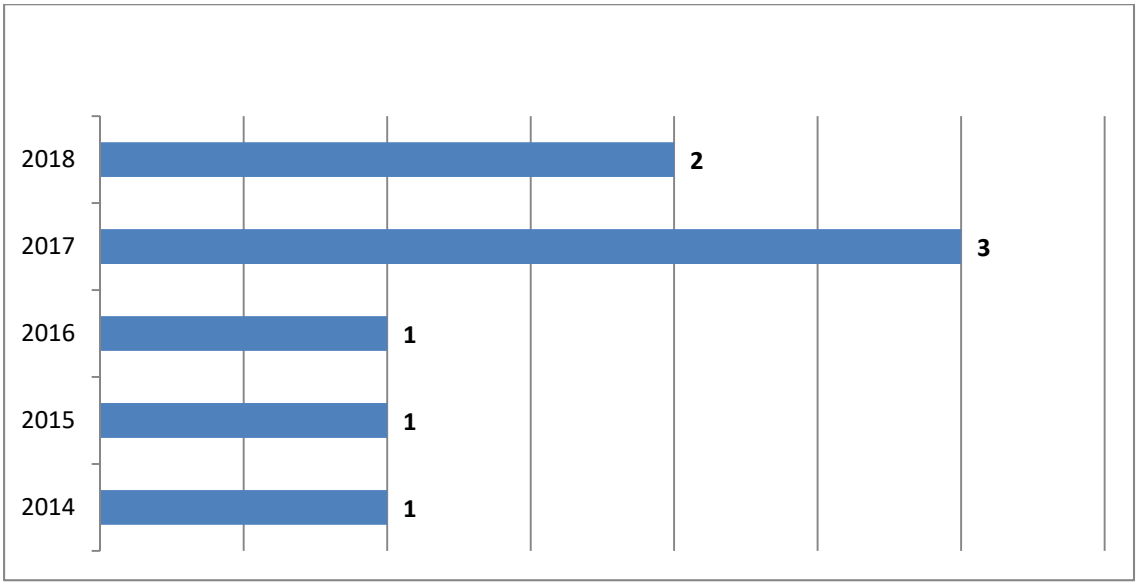

Figure 8: *Distribution of mobile-based assessment acceptance studies based on years of publication.*

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RQ2h: In the selected studies of MBA acceptance, What are the active countries in the context?

Mobile-based assessment acceptance studies have been carried out mainly in European countries, notably Greece. According to Figure 9, Greece has been the focus of 50% of the studies on MBA acceptance. Research from other parts of Europe makes up the other half of the MBA acceptance literature.

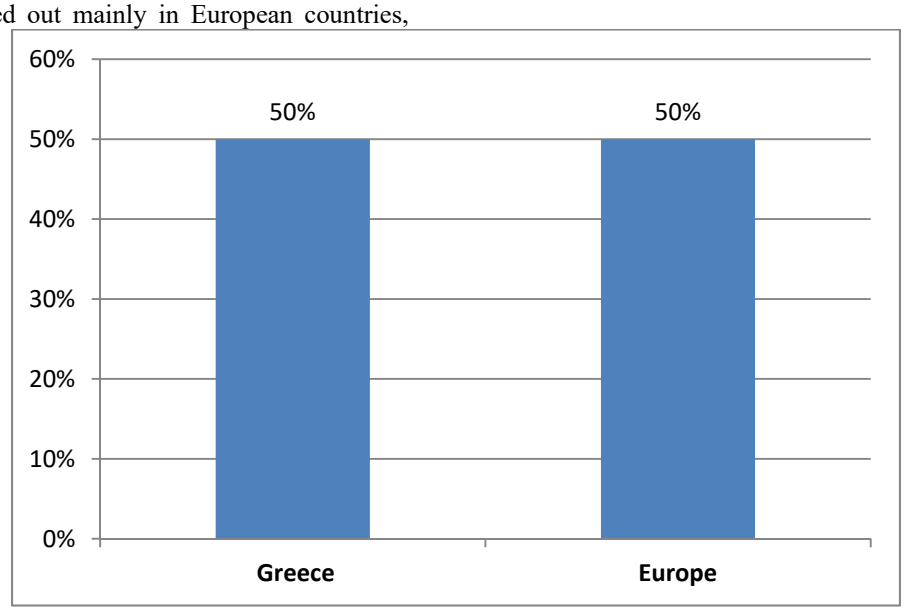

Figure 9: *Distribution of mobile-based assessment acceptance studies based on countries.*

None of the articles conducted in developing countries like Jordan studies the acceptance and usage of MBA as a tool for learning in universities or schools. Therefore, more research is needed to investigate this issue in other parts of the world.

Summary of the identified research gaps and future research for research questions

After conducting a literature review concerning mobile-based assessment acceptance, an overview of the research gaps and future research for each research question is presented in the following.

RQ1: Mobile-based assessment studies from the research purpose

In the reviewed studies, mobile-based assessment has been mainly focused on evaluating the effectiveness and performance of mobile-based assessment system (81%). While, few studies focused on acceptance, adoption or intention to use of mobile-based assessment. This gap is considered a new finding that is not raised in previous literature. Therefore, this study recommends conducting more studies to investigate this issue.

RQ2: With regard to the second research question, the systematic review focused on the studies related to acceptance, adoption or intention to use MBA

RQ2a: Mobile-based assessment acceptance studies from the main factors that have been studied in the context of mobile-based assessment acceptance

Most of the reviewed articles are based on investigating the effect external factors like (autonomy, relatedness, competency, mobility, satisfaction, perceived ubiquity value, mobile self-efficacy, content, perceived interactivity, perceived collaboration) Other important factors were ignored like technological factors, enjoyment factors, system quality factors, cultural factors and others. Therefore, it would be interesting to focus on these factors in future studies of mobile-based assessment acceptance.

RQ2b: Mobile-based assessment acceptance studies from the impact of external factors on mobile based assessment acceptance

Figure 4 shows that 60% of the external factors had a positive effect on students' acceptance of

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mobile-based assessment. 35% of the external factors revealed had a negative impact, and 5% did not have any effect. However, further investigation is needed to predict which external factors can enhance the acceptance and use of mobile-based assessment among students.

RQ2c: Mobile-based assessment acceptance studies from the main models and theories of technology acceptance that were used

The majority of the reviewed articles revealed that TAM is the most used model for predicting the acceptance of mobile-based assessment. This result is consistent with previous studies (e.g., [8]; [4]). Also, none of the reviewed articles predicts the acceptance of mobile-based assessment based on other models of technology acceptance such as the unified theory of acceptance and use of technology (UTAUT), innovation diffusion theory (IDT), and DeLone and McLean information system success model (DL&ML). Based on the current review, more research is needed that incorporates the UTAUT, IDT and DL&ML models.

RQ2d: Mobile-based assessment acceptance studies from the main research design and method

All reviewed articles reported that the dominant methodology for data collection in the context of mobile-based assessment acceptance is the questionnaire. This result is consistent with the previous review research conducted by [26]. They reported that the questionnaire was the primary method for data collection in MBA studies because it is the best method to determine the relationship between the factors in the conceptual model. However, the questionnaires are not always appropriate, so research is needed that employs other means of data collection like interviews and the Delphi technique. Incorporating these methods will give more comprehensive data related to MBA acceptance, especially from the students' point of view, as well as experts in the field of m-learning and MBA.

RQ2e: Mobile-based assessment acceptance studies from the main disciplines/contexts

A high percentage of the reviewed papers were conducted in the scientific context (e.g. biology, medical, science technology, engineering and mathematics). Few studies have been undertaken in the social, humanities and education sciences to investigate the acceptance and usage of mobile-based assessment in these contexts. Therefore, more investigation is needed.

RQ2f: Mobile-based assessment acceptance studies from the main educational levels and learning domain

Based on the analysis of the reviewed articles, it is interesting to note that only two studies were conducted in a university setting. Therefore, further research is needed to investigate the key factors that effect on mobile-based assessment acceptance among university students.

RQ2g: Mobile-based assessment acceptance studies from the years of publication

Few articles investigated the acceptance of mobile-based assessment, with just eight studies conducted between 2014 and 2018. Many researchers indicated the importance of studying the acceptance of mobile learning as an essential step in the use and advancement of mobile learning [6]; [5] However, despite the already known benefits provided by mobile-based assessment; the widespread use and acceptance of MBA is still controversial and requires further investigation ([16]; [56]).

CONCLUSIONS

Few literature reviews exist on mobile-based assessment, and none of the previous studies provides a comprehensive analysis of the current status of the research on mobile-based assessment acceptance. Therefore, in this study, a systematic review was conducted to provide insight into the research trends of MBA acceptance. Specifically, research purpose, external factors, technology acceptance models used, research design and method, disciplines/contexts, educational levels and learning domain, years of publication, and country.

This study is the first to provide a comprehensive analysis of the literature about mobile-based assessment acceptance and presents eight new findings. First, in the reviewed articles, the majority of MBA studies focused on evaluating the effectiveness and performance of mobile-based assessment system. Second, only ten external factors that have been investigated so far in mobile-based assessment acceptance studies.

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Third, TAM is the preferred model for studying the mobile-based assessment acceptance in most of the reviewed articles. Fourth, the questionnaire is the preferred research method for data collection in most of the reviewed studies. Fifth, most studies were applied in a scientific context (e.g. biology, medical, science technology, engineering and mathematics). Sixth, the majority of reviewed articles were conducted at the secondary school level. Seventh, the number of studies conducted between 2014 and 2018 is very little (only eight studies). Eighth, Greece is the focus of most studies on mobile-based assessment acceptance.

In addition to the findings above, this literature review study identified six research gaps related to mobile-based assessment acceptance literature like the following: First, further research is needed to study the acceptance problem of a mobile-based assessment system. Second, further investigation is required to predict which external factors that can enhance the acceptance and use of mobile-based assessment among students. Third, more research is needed for extending the technology acceptance models such as UTAUT, IDT and DL&ML on mobile-based assessment acceptance studies. Fourth, more research is necessary to employ other data collection methods such as interviews and the Delphi technique to understand the real problems that face acceptance of mobile-based assessment from the perspective of students, as well as experts in the field of mobile learning and mobile-based assessment. Fifth, more research is needed with participants from higher education level (university students). Sixth, more research is required to investigate this issue in developing countries like Jordan and others.

Finally, the findings of this review study provide a valuable reference for researchers about the current trend of mobile-based assessment research as well as the research gaps that should be covered in future studies.

RESEARCH LIMITATIONS

This review study only focused on articles published in four top-ranked databases like ScienceDirect, Wiley, IEEE and Google scholar. Based on that, these databases may not provide all articles published on mobile-based assessment acceptance. Future research could expand the current study by including articles from other databases such as Emerald, Springer, Sage, ACM Digital Library and others.

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