Student Perception of Mobile Self-assessment: an Evaluation of the Technology Acceptance Model.

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Abstract. Assessment has always been a very important step in the learning process. The use of mobile devices for assessment makes possible the creation of new types of assessment activities. MobiSWAP (Mobile Semantic Web Assessment Personalization) system provides mobile self-assessment resources considering contextual information. Mobile self-assessment offers ubiquitous access to testing material anytime and anyplace. It has the potential to complement and to enhance other assessment delivery modes (i.e. paper-and-pencil based assessment and computer-based assessment). However, the effective development of a mobile self-assessment depends essentially on students' acceptance. The research purpose aims to build a model that demonstrates the factors that affect university students' intention to use a mobile self-assessment. An experiment study was conducted with 40 university students enrolled in an Object Oriented Programing course. Experiment's results help to derive the factors that influence the use of self-assessment in mobile environment. The proposed model, Mobile Self-Assessment Acceptance Model (MSAAM) combines two theoretical frameworks: Technology Acceptance Model (TAM) and Self-Determination Theory of Motivation (SDT). Partial Least Squares (PLS) was used to test the measurement and the structural model. Results indicate that Perceived Ease of Use and Attitudes Towards Use have a direct effect on mobile self-assessment Intention to Use. Perceived Usefulness, Competency, Autonomy and Relatedness have only indirect effects. The study confirms Technology Acceptance Model and showed that Self Determination Theory can be useful in predicting students' acceptance in the context of mobile self-assessment.

Keywords: Devices for Learning, Mobile and Personal Devices, E-Learning Tools, Self-Assessment Technologies.

1 Introduction

The advancement and popularity of mobile technologies have encouraged researchers to adopt portable computers and mobile devices in conducting learning activities [1] [2]. Mobile technologies can facilitate learning "anytime and anyplace", offering a

continuous learning experience that is personal, situated and contextual [3]. Handling mobile devices in education have emerged new forms of learning and assessing systems [4][5][6]. All educational processes can be facilitated even revitalized through mobile technologies [7].

Self-assessment in an educational setting involves students making judgments about their own work. Students can make assessment decisions regarding their own essays, performances, dissertations and even exams [8].

Recently, mobile technologies have been used in assessment. Mobile assessment is a new delivery mode of assessment that offers ubiquitous access to testing material anytime and anyplace. Due to its mobile features, it has the potential to complement and enhance other assessment delivery modes i.e. paper-and-pencil based or computer-based assessment [9]. A variety of mobile assessment types can be distinguished: self-assessment, peer-assessment, adaptive assessment, context-aware assessment, game-based assessment. All these types can be implemented using mobile devices [10].

Mobile self-assessment can be used both in formal and informal settings [11]. In the context of formal setting, the usage of mobile devices like smartphones increases student attention and engagement. In the context of informal setting when students have more control over their assessment goals and process, mobile self-assessment can be particularly beneficial [12]. In fact, students think that mobile devices would allow them to execute self-assessment test activities during their spare time (for instance while traveling or waiting for public transport, etc.). In this way, they can self-assess and better prepare for an exam when they cannot use a PC.

Considering the increased use of mobile assessment, researchers try to identify the factors that affect learners to use in order to implement it successfully. In fact, the large field of possible educational settings and application areas where mobile self-assessment can be applied makes important to investigate its user adoption. Technology acceptance models help to improve the system's implementation. In fact, the determination of factors influencing the use or the adoption of a system by its end-users makes possible to ameliorate his implementation. The modification of certain functionalities still also possible making the system more suitable and more appropriate to the users' expectations.

A literature review clarifies that there are many studies examining the acceptance of computer-based assessment [8][13] and others for the acceptance of mobile learning [14][15][16]. But, the determination of the factors that influence the acceptance of mobile self-assessment remains little studied [40] [41].

In the present study, we try to justify and to prove which factors affect the university students' acceptance and intention to use of mobile self-assessment. The present study combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation. Partial Least Squares were used to test the hypothesized relationship among the variables in the model.

The rest of this paper is organized as follows; the next section describes the most related previous research works on mobile learning and mobile assessment. After the literature review, the methodology and the results of the proposed research model are described. Thereafter, results are discussed as well as conclusions are presented.

2 Theoretical Background

In recent years, mobile learning is of major use especially with the large evolution of mobile technologies. But, the use of mobile technology for assessment especially in formal setting (e.g. final exam degree) remains some limitation. In fact, mobile devises' users feel anxious when they mobile technologies for assessment. To ensure

its successful use in an academic context, we determine its acceptance's degree and adoption by university students. Mobile self-assessment can be attributed to several effective factors: personal, social or level of technology.

Before exploring the mobile self-assessment acceptance factors, foundations of theories and previous study on technology adoption has been explored. A number of theories have been explored to explain the concept of technology acceptance: the Theory of Reasoned Action (TRA) [17], the Theory of Planned Behavior (TPB) [18], the Innovation Diffusion Theory (IDT) [19] and the Technology Acceptance Model (TAM) [20]. TAM is the most dominant model regarding technology acceptance. It focuses on two particular constructs of perceived usefulness and perceived ease of use as drivers of technology acceptance. Perceived ease of use and perceived usefulness predict attitude towards use of a technology. Then, attitude towards use predicts the intention to use indicating the actual acceptance of a technology [21]. In summary, TAM in its original formulation as specified by Davis [20] includes four concepts: ease of use, usefulness, attitude towards use and intention to use as show in Fig. 1.

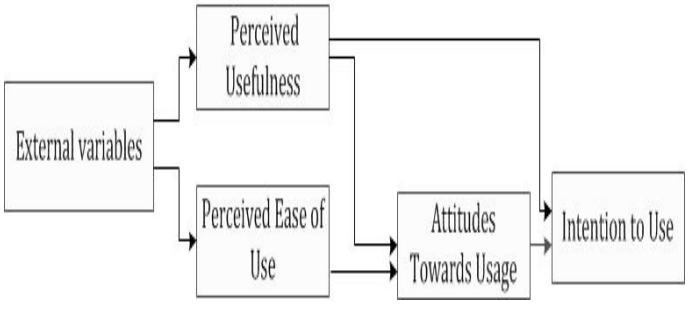

Fig.1. Technology acceptance Model [20]

The TAM is a very useful theoretical model that has been tested in many empirical studies. In the educational field, TAM is used as a tool to determine the degree of students' learning acceptance.

Students' perceptions of mobile self-assessment need to be investigated at the initial step of implementing mobile assessment in higher education. Therefore, it is necessary to conduct research that identifies factors that university students consider important in the acceptance of mobile self-assessment. Some studies have investigated the acceptance of mobile learning and computer based-assessment using TAM. However, a limited number of studies have investigated the acceptance of mobile assessment [9] [10] [41] [42]. Therefore, there is a need to clarify the effect of mobile devices experience on the acceptance of assessment.

In the following, we explain how TAM has been addressed respectively in, mobile learning, web based computer assessment and mobile assessment. Our objective is to understand the factors driving respectively, mobile learning, web based-assessment and mobile assessment adoption using TAM.

2.1 TAM and mobile learning

TAM has been successfully used as a framework to study learner's acceptance of mobile learning. The general structural model elaborated by [14] is based on the TAM. The research model consists of eight constructs including: mobile learning self-

efficacy, relevance for students' major, system accessibility, subjective norm, perceived usefulness, perceived ease of use, mobile learning attitude, and behavioral intention to use mobile learning. The study results confirmed the acceptability of the model to explain students' acceptance of mobile learning. Mobile earning attitude forms the most important construct in explaining the causal process in the model.

The study [15] integrates perceived enjoyment from the motivational model and perceived mobility value as an external variable of perceived usefulness to explain and to predict the acceptance of mobile Learning. The findings results show that perceived usefulness and perceived ease of use influence positively and significantly students' attitude towards use mobile learning. In addition, Attitude positively and significantly affects intentions to use mobile learning. Results also indicate that individual differences have a great impact on user acceptance and that the perceived enjoyment and perceived mobility can predict user intentions to use mobile learning.

Liu et al. developed also a conceptual model to examine factors affecting the adoption intention of mobile learning [16]. Their findings indicate that perceived usefulness and personal innovativeness have significant influence on mobile learning acceptance. Personal innovativeness is a predictor construct of both the perceived ease of use and perceived usefulness.

Including subjective norm and individual differences Wei-Han et al. developed a conceptual model to examine factors affecting the acceptance of mobile learning in Malaysia [22]. Findings indicate that perceived usefulness, perceived ease of use, and subjective norm are positively associated with intention to adopt mobile learning. Further, gender factor did not show significant effect on intention towards mobile learning usage in their study.

2.2 TAM and computer based-assessment

The effective development of a computer based assessment depends essentially on students' acceptance. There are numerous studies examining the acceptance of computer based-assessment using TAM.

The study proposed by Terzis and Economides aims to build a model that demonstrates the constructs that affect students' behavioral intention to use a computer based-assessment [8]. The proposed model, Computer Based Assessment Acceptance Model (CBAAM) is based on TAM, Theory of Planned Behavior TPB (TPB) and the Unified Theory of Acceptance and Usage of Technology (UTAUT). Constructs such as Perceived Usefulness, Perceived Ease of Use, Computer Self Efficacy, Social Influence, Facilitating Conditions and Perceived Playfulness are used. Additionally, two new variables, Content and Goal Expectancy, were added to the proposed research model. Results indicate that Perceived Ease of Use and Perceived Playfulness have a direct effect on computer based-assessment use. Perceived Usefulness, Computer Self Efficacy, Social Influence, Facilitating Conditions, Content and Goal Expectancy have only indirect effects.

In another study using TAM, Terzis and Economides aim to explore the continuance acceptance in computer based assessment and the development of a new approach for continuance use [13]. The approach is applied by measuring user's expectations before the interaction with the system and user's perceptions after the interaction. Results underline Confirmed Ease of Use and Confirmed Playfulness as the direct determinants of continuance acceptance.

The user's acceptance of Computer Based Assessment Systems is examined with the help of the Computer Based Assessment Acceptance Model (CBAAM) in the two different cultures of Greece and Mexico [23]. The study was conducted by delivering the same computer based-assessment system to students of identical courses in Greece and Mexico. The results indicate that the CBAAM is valid for both countries in

overall. However, there are some cultural differences. Greek students' behavioral intention is triggered mainly by Perceived Playfulness and Perceived Ease of Use, while Mexican students' behavioral intention is caused by Perceived Playfulness and Perceived Usefulness.

Table 1. RELATED WORKS AND MAINLY OBTAINED RESULTS

Study	Results
TAM and mobile learning	
[14]	Mobile learning Attitude forms the most important construct in explaining the causal process in model
[15]	Perceived usefulness and perceived ease of use influence students' attitude towards use mobile learning. Mobile learning Attitude affects intentions to use mobile learning.
[16]	Perceived usefulness and personal innovativeness have significant influence on mobile learning acceptance. Personal innovativeness is a predictor construct of both the perceived ease of use and perceived usefulness.
[22]	Perceived usefulness, perceived ease of use and subjective norm are positively associated with intention to adopt mobile learning.
TAM and web based computer assessment	
[8]	Perceived Ease of Use and Perceived Playfulness have a direct effect on CBA use. Perceived Usefulness, Computer Self Efficacy, Social Influence, Facilitating Conditions, Content and Goal Expectancy have only indirect effects.
[13]	Confirmed Ease of Use and Confirmed Playfulness are the direct determinants of continuance acceptance.
[23]	The CBAAM is valid for both countries. Greek students' behavioral intention is triggered mainly by Perceived Playfulness and Perceived Ease of Use, while Mexican students' behavioral intention is caused by Perceived Playfulness and Perceived Usefulness.
TAM and mobile assessment	
[9]	Perceived Autonomy, Perceived Relatedness and Perceived Competency, along with Perceived Usefulness and Perceived Ease of Use, influence Attitudes Towards Use and Behavior Intention to use Mobile-Based Assessment.
[41]	The proposed model explains and predicts students' intention to use mobile based assessment in terms of both acceptance and motivational (autonomy, competence and relatedness) factors.

2.3 TAM and mobile assessment

A bibliographic research survey on mobile assessment and TAM's use reports the following research works. Nikou and Economides examine the factors that influence the acceptance of mobile-based assessment [9]. The proposed model combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation. Perceived Autonomy, Perceived Relatedness and Perceived Competency, along with Perceived Usefulness and Perceived Ease of Use, influence Attitudes Towards Use and Behavior Intention to use mobile-based assessment. The study confirms Technology Acceptance Model and showed that Self Determination Theory can be useful in predicting students' acceptance in the context of mobile-based assessment. In [41], authors propose a study build on the theoretical framework of the Self-Determination Theory of Motivation and the Technology Acceptance Model and propose the Mobile Based Assessment - Motivational and Acceptance Model (MBA-MAM), a combined model that explains and predicts Behavioral Intention to Use Mobile-based.

Table I summarizes the cited related works used later to develop our proposed model and illustrates mainly obtained results.

This study combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation to develop a model of mobile self-assessment acceptance that would help educators to identify the factors that influence the technology acceptance.

3 Methodology and Gathering Techniques

3.1 System

A mobile self-assessment system MobiSWAP (Mobile Semantic Web Assessment Personalization) built for a previous experiment [6] was adjusted to serve the needs of the current study. The purpose of this study is to determine factors influencing the acceptance of mobile self-assessment as it is described and provided by MobiSWAP. In [6], the basic functionalities of MobiSWAP were tested by university's students.

MobiSWAP includes basic functions providing learners with appropriate mobile self-assessment resources considering contextual information (used device, place, time, learner's level).

The system allows generating assessment tests based on context information and personalized to student profile. It is based on Web services and semantic Web technologies [24]. MobiSWAP operates a set of ontological models [25] [26]. The system is based on an assessment resources retrieval algorithm. The algorithm allows to personalize assessment tests to the learner profile and to adapt to the context [27].

3.2 Research model and hypotheses

The MSAAM (Mobile Self-Assessment Acceptance Model) was applied to university students in order to examine the acceptance and the use of self-assessment to improve learning in mobile situation. This section describes the MSAAM's variables and hypotheses.

The proposed research model combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation [28]. According to the Self-Determination Theory of Motivation theory, a basic set of psychological

needs must be satisfied in order to enhance intrinsic motivation. These needs are autonomy, competence and relatedness [9]. We assume that perceived autonomy (A), perceived competence (C) and perceived relatedness (R) form the three external variables in our proposed research model, MSAAM.

Autonomy reflects the learners' desire to self-initiate and self-regulate their own behavior. In mobile environments, learners have a strong sense of mobile devices' ownership. This sense can be transformed to a learning property. Similarly, the control of the assessment process is considered among the motivation factors in a mobile context. Therefore, the various self-regulation and property factors can be conceptualized as a perceived autonomy (A). Therefore, we assume the following hypothesis:

H1. *University students' perceived Autonomy (A) when using mobile devices to self-assessment will have a positive influence on the mobile self-assessment Perceived Usefulness (PU).*

Competence refers to the desire to feel effective in attaining valued outcomes [28].It refers to human needs to achieve effective results. The majority of learners have a convenience to use mobile devices to complete some activities such as Web navigation. Learning activities such as mobile self-assessment can be perceived as an experience that improves learner's skills in mobile situations. Therefore, we have consequently established the following hypotheses:

H2. *University students' perceived Competence (C) when using mobile devices to assessment will have a positive influence on the mobile self-assessment Perceived Usefulness (PU).*

H3. *University students' perceived Competence (C) when using mobile devices to assessment will have a positive influence on the mobile self-assessment Perceived Ease of Use (PEOU).*

Relatedness refers to the human need to feel connected and affiliated to other of his environment. The use of mobile devices provides rich social interaction allowing users to collaborate and to share information. Therefore, we propose the following hypothesis:

H4. *University students' perceived Relatedness (R) when using mobile devices to assessment will have a positive influence on the mobile self-assessment Perceived Usefulness (PU).*

Perceived Usefulness (PU) presents the degree to which a user considers that using a specific system/technology will improve his/her performance [20]. Therefore, we hypothesized:

H5. *University students' Perceived Usefulness (PU) will have a positive effect on Attitudes Towards Use (ATU) mobile self-assessment.*

H6. *University students' Perceived Usefulness (PU) will have a positive effect on Intention to Use (ITU) mobile self-assessment.*

Perceived Ease of Use (PEOU) constitutes the degree to which a user considers that using a system would be free of effort [20]. Mobile learning and assessment acceptance models showed that the Perceived Ease of Use (PEOU) influences positively and directly the Perceived Usefulness (PU), the Attitudes Towards Use (ATU) and the Intention to Use (ITU) [29] [30].Therefore, we present the following three hypotheses:

H7. *University students' Perceived Ease of Use (PEOU) will have a positive effect on Attitudes Towards Use (ATU) mobile self-assessment.*

H8. *University students' Perceived Ease of Use (PEOU) will have a positive effect on Intention to Use (ITU) mobile self-assessment.*

H9. *University students' Perceived Ease of Use (PEOU) will have a positive effect on Perceived Usefulness (PU) mobile self-assessment.*

The degree to which a user is interested to a specific system/technology is the

Attitude Towards Use (ATU) [20]. ATU influences positively and directly the Intention to Use (ITU). Therefore, we hypothesized:

H10. *Attitudes Towards Use (ATU) will have a positive effect on Intention to Use (ITU) mobile self-assessment.*

Respecting the previously hypotheses, we propose the following mobile self-assessment conceptual model (Fig.8).

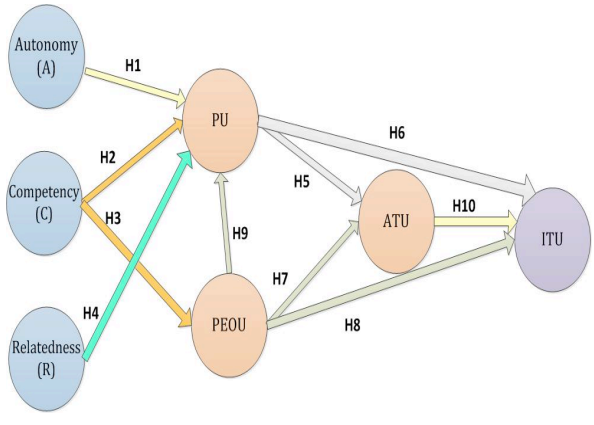

Fig.2. Mobile self-assessment conceptual model.

3.3 Data collection

The survey study was conducted with university students, enrolled in an OOP (Object Oriented Programing) course, in a Tunisian University, Higher Institute of Computer Science and Management of Kairouan, in Tunisia. The participation in the procedure was voluntary. 40 computer sciences students, 27 having intermediate level in OOP course (67.5%) and 13 having beginner level (32.5%) are concerned in the procedure. Students have already completed a first experimentation to evaluate the personalization and adaptable MobiSWAP system's functionalities [6].

3.4 Instrument

The objective of the following experiment is to test the acceptance of mobile self-assessment as an activity to improve and to enhance learning in mobile situations. To this end, the mixed evaluation method proposed by Martinez et al. [31] has been selected due to the characteristics of the educational context including participants, used devices and learner's place. The mixed method combines quantitative techniques and sources, such as closed questions or event log files generated automatically by the system, with qualitative techniques, such as open-ended questions and first-hand observations [32]. To evaluate the case study according to the mixed method, students' perceptions about the experiment were collected in a paper-based questionnaire delivered immediately after the first experiment [6]. The questionnaire operationalizes different variables of our proposed research model (Appendix A).

After the end of the procedure, 40 students have to answer the questionnaire survey (MSAAM) as illustrated in Appendix A. MSAAM consists of 24 items in order to measure its 7 latent variables (fig.8). To assess students' perceived Autonomy (A)

support we have used 4 items. For perceived Relatedness (R) we used 3 items and for perceived Competency (C) we used 4 items. To assess Attitudes Towards Use (ATU) we have used 3 items. For the Intention to Use (ITU) we employed 4 items and for the Perceived Ease of Use we have used 3 items. Questions were adapted from previous studies while making some changes reflecting the targeted technology in our framework [33][34]. Some modifications of items were made in order to describe the current research context mobile self-assessment. We used the seven point Likert-type scale with 1 = "strongly disagree" to 7 = "strongly agree", in order to measure the items. To conclude, our measurement instrument consists of 24 items and our research model consists of seven constructs (Appendix A).

3.5 Data analysis and results

Table 2. Results for the measurement model: convergent validity

Construct item	Mean (SD)	Factor Loading (> 0.7)	Cronbach a (> 0.7)	Composite Reliability (> 0.7)	AVE (> 0.5)
A	5.333 (1,600)		**0.791**	0.864	0.615
A1		0.800			
A2		0.703			
A3		0.826			
A4		0.802			
C	5,635 (1,275)		**0.864**	0.907	0.711
C1		0.854			
C2		0.837			
C3		0.744			
C4		0.928			
R	5,248 (1,333)		**0.845**	0.907	0.765
R1		0.891			
R2		0.927			
R3		0.801			
ATU	4,666 (1,650)		**0.808**	0.885	0.719
ATU1		0.810			
ATU2		0.844			
ATU3		0.889			
PEOU	5,692 (1,435)		**0.797**	0.880	0.711
PEOU1		0.748			
PEOU2		0.939			
PEOU3		0.832			
PU	4,966 (1,696)		**0.823**	0.902	0.754
PU1		0.837			
PU2		0.901			
PU3		0.838			
ITU	5,034 (1,414)		**0.803**	0.884	0.718
ITU1		0.839			
ITU2		0.848			
ITU3		0.854			

The MSAAM research model was tested and analyzed using Partial Least Squares (PLS) [35] [38]. PLS was used as an analysis technique to predict factors influencing mobile self-assessment adoption. PLS is component-based and uses a least-squares estimation procedure. It is more suitable for our research because it provides several advantages [8]: (1) fewer demands on residual distributions; (2) smaller sample; (3) wider number of constructs and/or indicators; (4) testing theories in early stages of development and (5) better for prediction. Thereby, smartPLS3 (v.3.2.0) was used for the analysis [37]. SmartPLS is one of the leading tools for practical least squares structural equation modeling.

Reliability and validity for the measurement model are measured through convergent validity and discriminant validity [35] [38].Convergent and discriminant validity need to be verified in order to ensure the quality of the model. From a statistical point of view, convergent validity was examined for each construct by the verifying the following four criteria:

1. All the indicators Factor Loadings should exceed 0.7.
2. The Composite Reliability (CR) of each construct should exceed 0.7.
3. The Average Variance Extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (AVE > 0.5).
4. The Cronbach Alpha (a) value of each construct should exceed 0.7 (a >0.7).

Table 2 confirms the convergent validity. All the factor loadings of the items in the measurement model exceed the demand value (0.7). Moreover, all Composite Reliability (CR) values range from 0.864 to 0.907 and the Average Variance Extracted (AVE) values alter from 0.615 to 0.765 which exceed the adequate values, respectively (0.7 and 0.5).The consistence between different items is verified by calculating the Cronbach Alpha (a) value which exceeds 0.7 for all constructs. Thereby, all criteria for convergent validity are satisfied.

Discriminant validity is supported when the square root of the Average Variance Extracted (AVE) of a construct is higher than any correlation with another construct. This means that a construct correlation with its indicators is higher than any correlation with another construct. Table 3 reports the square root of the average variance extracted of each construct (the diagonal elements are the AVE). All the AVE are greater than any other correlation. Consequently, the discriminant validity of the proposed research model is confirmed.

SmartPLS3 was also used to examine the statistical significance of the relations in the model. A boot strapping procedure was applied. The calculated R2 values, the significances of the path coefficients as well as the t-values and the total effects are the criteria used to assess our structural model and its hypotheses.

Table 3. Results for the measurement model: discriminant validity

	A	ATU	C	ITU	PEOU	PU	R
A	**0.784**						
ATU	0.314	**0.848**					
C	0.301	0.487	**0.843**				
ITU	0.370	0.715	0.598	**0.847**			
PEOU	0.344	0.468	0.502	0.619	**0.843**		
PU	0.514	0.574	0.657	0.592	0.682	**0.869**	
R	0.353	0.669	0.557	0.789	0.766	0.749	**0.875**

The correlation coefficient measures the robustness of the relationship between two variables.

A correlation is significant if the (t-value) exceed 1.96. Positive correlation coefficients close to +1 assume a strong correlation link while those who are close to

0 indicate a weak correlation link between constructs. Figure 3 and Table 4 summarize the hypothesis testing results.

We found support for seven out of ten hypotheses in our proposed model. Regarding the Perceived Usefulness, we find a direct positive effect of Perceived Autonomy, Perceived Competency and Perceived Relatedness but no direct effect of Perceived Ease of Use. Intention to Use has a direct positive effect on Attitudes Towards Use and Perceived Ease of Use but no direct effect of Perceived Usefulness. Attitudes Towards Use has a direct positive impact of Perceived Usefulness but no direct effect of Perceived Attitudes Towards Usage. Finally, Perceived Attitudes Towards Use has no direct effect of Perceived Competency.

Table 4. Results for the measurement model: discriminant validity

Hypothesis	Path	Path coefficient	t-value	Support
H1	A →PU	0.236	2.595	*Yes*
H10	ATU → ITU	0.523	4.300	*Yes*
H3	C→ PEOU	0.502	2.884	*Yes*
H2	C → PU	0.294	2.461	*Yes*
H7	PEOU → ATU	0.142	0.630	**No**
H8	PEOU → ITU	0.327	2.059	*Yes*
H9	PEOU → PU	0.167	1.104	**No**
H5	PU → ATU	0.477	2.367	*Yes*
H6	PU → ITU	0.068	0.438	**No**
H4	R → PU	0.373	2.316	*Yes*

Referring to Table IV, our results suggest:

- Attitudes Towards Use is attributed to Perceived Usefulness.
- Perceived Usefulness is attributed to Perceived Autonomy, Perceived Relatedness, and Perceived Competency.
- Perceived Ease of Use is attributed to Perceived Competency.
- Intention to use is attributed to Attitudes towards use and Perceived Ease of Use.

Figure 3 summarizes the structural model results along with the path coefficients shown above each path and the R2 values. The model explains almost the 62% (R2 = 0,617) of variance in Intention to Use. The study demonstrated that students have a strong Intention to Use the mobile self-assessment for learning. The total effects of A (0,075), C (0,322), R (0,523), PU (0,318), PEOU (0,455) and ATU (0,523) on PU are adequately strong to explain the Intention to Use. This indicates that these constructs are very important for the explanation of the Intention to Use. Furthermore, A (0,236), C (0,294), R (0,373) and PEOU (0,167) explain 71% (R2 = 0,708) of the variance in Perceived Usefulness. Moreover, PU (0,477) and PEOU (0,142) explain 34% (R2 = 0,340) of the variance in Attitudes Towards Use. Finally, Perceived Competency (0,502) explains 25% (R2 = 0,252) of the variance in Perceived Ease of Use (Figure.3, Table 4).

3.6 Discussions

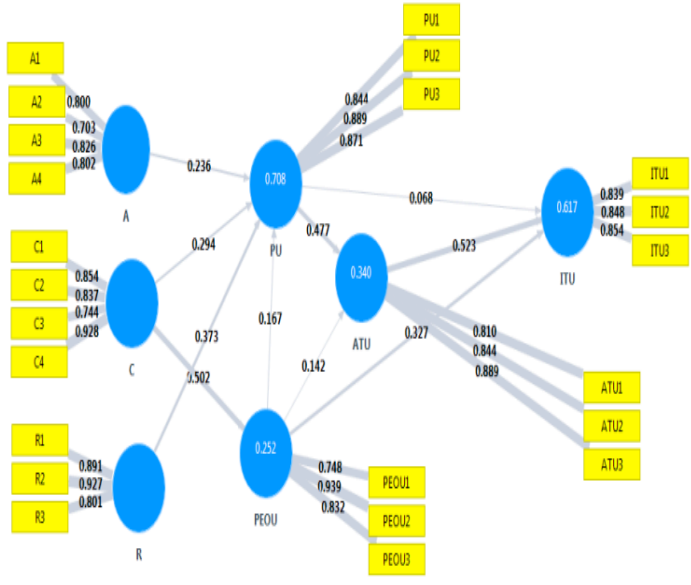

Fig.3. Path coefficients of the research model (MSAAM).

3.6 Discussions

Mobile assessment is a new delivery mode of assessment that offers ubiquitous access to testing material "anytime and anyplace". It is part of mobile learning technologies. The aim of this study is to extend prior knowledge about the technology acceptance model and customize it for mobile self-assessment. Previous studies have effectively applied the TAM model in the context of mobile learning and computer based-assessment.

This is among the first studies investigating the factors that influence the intention to use mobile self-assessment from the combined perspective of Self-Determination Theory of Motivation and the Technology Acceptance Model [9] [41].

The results demonstrate that Attitudes Towards Use (ATU) and Perceived Ease of Use (PEOU) have a direct effect on Intention to Use (ITU). While, Perceived Usefulness (PU), Competency (C), Autonomy (A) and Relatedness (R) have an indirect impact on Intention to Use (ITU). Our study confirms prior study and the data supports our research measurement and structural model [7][9].

According to the direct effects on Intention to Use (ITU), we conclude that when a mobile self-assessment system is easy to use and has a positive attitude towards use, it would be more likely for students to adopt and to use it. Attitudes Towards Use (ATU) and Perceived Ease of Use (PEOU) are two of the major constructs in TAM and the direct effect on Intention to Use (ITU) was expected.

The self-determination theory three variables' namely: Competency (C), Autonomy (A) and Relatedness (R) have a direct effect on Perceived Usefulness (PU). Our hypothesis for a direct impact of the Perceived Usefulness (PU) on Intention to Use (ITU) was not confirmed (H6). However, Perceived Usefulness has a significant direct effect on Attitudes Towards Use (ATU) who affects positively the

Intention to Use (ITU). Thus, the theory self-determination three variables' have a strong indirect effect on Intention to Use (ITU) through the two intervening variables PU and ATU. Based on our results, when students' basic psychological needs are satisfied, the motivation's level to use mobile self-assessment increases. In fact, if student competency, autonomy and relatedness are supported, students feel more motivated to adopt mobile self-assessment technology.

Our model shows that Competency (C) has a direct positive effect on Perceived Ease of Use (PEOU). It means that a student who feels competent when using computers or mobiles devices he/she will find easy to use mobile self-assessment systems.

Furthermore, Perceived Ease of Use (PEOU) has no direct effect on Attitudes Towards Use (ATU) and on Perceived Usefulness (PU). Indeed, a system's ease of use does not imply its adoption to use and its usefulness. Students try to use assessment systems that meet more their learning needs and objectives.

4 Conclusion

Mobile assessment has the potential to find a wide range of use in mobile learning and blended learning approaches. Therefore, predicting its adoption from a motivational perspective can be useful for educators to design and implement motivational mobile assessment approaches. This study investigated the factors that impact the Intention to Use a mobile self-assessment by university students. It is among the first towards the investigation of the factors that influence the acceptance of mobile self-assessment.

The proposed model, MSAAM, combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation. PLS was used to test the measurement and the structural model. Our measurement and structural model were supported from our data. Results indicate that Perceived Ease of Use and Attitudes Towards Use have a direct effect on mobile self-assessment Intention to Use. Perceived Usefulness, Competency, Autonomy and Relatedness have only indirect effects. These seven variables explain approximately 62% of the variance of Intention to Use. Our finding our results reinforce those found in [6] to predict mobile self-assessment acceptance.

Our analysis indicates that the Perceived Usefulness has no direct effect on Intention to Use mobile self-assessment. This is a controversial result. In fact, previous studies support a very strong effect of Perceived Usefulness on Intention to use (e.g. TAM). Further studies have to be developed in order to show if Perceived Usefulness has no direct effect on Intention to Use a mobile self-assessment.

As future work we plan to test the MobiSWAP system with a larger number of learners. In fact, our first experiment was conducted with a small number of individuals (40 university students). A sample with more students may provide different and more significant results. Moreover, the sample is very specific. All participants are third-year undergraduate students registered in an Oriented Object Programing course. Similar studies should be applied to other groups with different characteristics (age, nationality and course's content).

References

[1] S. S. C. Young, and H.C. Hung, "Coping with the challenges of open online education in Chinese societies in the mobile era: NTHU OCW as a case study", The International Review of Research in Open and Distributed Learning, vol.15, no.3, 2014.

[2] Y. Rogers and S. Price, "How mobile technologies are changing the way children learn", In A. Druin (Ed.), Mobile technology for children, pp.3–22, Boston: Morgan Kaufmann, 2009.
[3] J. Traxler, "Defining, discussing, and evaluating mobile learning: The moving finger writes and having write…", International Review of Research in Open and Distance Learning, vol. 8, no. 2, pp.1-12, 2007.
[4] Z. Bogdanović, D. Barać, B. Jovanić, S. Popović and B. Radenković, "Evaluation of mobile assessment in a learning management system", British Journal of Educational Technology, vol.45,no. 2, pp.231-244, 2014.
[5] P. Santos, J. Cook, J. and D. Hernández-Leo, "M-AssIST: Interaction and Scaffolding Matters in Authentic Assessment", Journal of Educational Technology& Society, vol.18, no.2, pp.33-45, 2015.
[6] A. Harchay, L. Cheniti-Belcadhi and R. Braham, "A Context-aware Approach for Personalized Mobile Self-Assessment", Journal of Universal Computer Science, vol. 21, no 8, pp.1061-1085, 2005.
[7] S. Nikou and A.A. Economides, "A model for Mobile-based Assessment adoption based on Self-Determination Theory of Motivation", IEEE International Conference on Interactive Mobile Communication Technologies and Learning (IMCL), 2014.
[8] T. Vasileios and A.A. Economides, "The acceptance and use of computer based assessment", Computers & Education, vol.56, no.4, pp.1032-1044, 2011.
[9] S. Nikou and A.A. Economides, "Acceptance of Mobile-Based Assessment from the perspective of Self-Determination Theory of Motivation", IEEE 14th International Conference In Advanced Learning Technologies (ICALT), pp. 454-458, 2014.
[10] S. Nikou and A.A. Economides, "Mobile Assessment: State of the art", in Z. L. Berge and L. Y. Muilenburg (Eds.), Handbook of mobile learning, Florence, KY: Routledge, pp.346-355, 2013.
[11] J.C.Y Sun, "Influence of polling technologies on student engagement: An analysis of student motivation, academic performance, and brainwave data", Computers & Education, vol.72, pp.80-89, 2014.
[12] C. Romero, S. Venture and P. De Bra, "Using mobile and web-based computerized tests to evaluate university students", Computer Applications in Engineering Education, vol.17, no.4, pp.435-447, 2009.
[13] T. Vasileios, N. M. Christos and A. A. Economides, "Continuance acceptance of computer based assessment through the integration of user's expectations and perceptions" Computers & Education, vol.62, pp.50-61, 2013.
[14] S.Y. Park, N. Min-Woo and C. Seung-Bong, "University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model." British Journal of Educational Technology, vol.43, no.4, pp.592-605, 2012.
[15] J. H. Huang, Y. R. Lin and S. T. Chuang, "Elucidating user behavior of mobile learning: A perspective of the extended technology acceptance model.", The Electronic Library, vol.25, no.5, pp.585-598, 2007.
[16] Y. Liu, H. Li and C. Carlsson, "Factors driving the adoption of m-learning: An empirical study." Computers and Education, vol.55, no.3, pp.1211-1219, 2010.
[17] I. Ajzen and M. Fishbein, "Understanding attitudes and predicting social behavior.", Englewood Cliffs, NJ: Prentice-Hall, 1980.
[18] I. Ajzen, "The theory of planned behavior." Organizational behavior and human decision processes, vol.50, no.2, pp.179-211, 1991.
[19] R. Agarwal and P. Jayesh, "The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies.", Decision sciences, vol.28, no.3, pp.557-582, 1997.
[20] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology.", MIS Quarterly, vol.13, no.3, pp. 319–340, 1987.

[21] B. Kargin, B. Nuri and D. Tugrul, "Customer Perspectives of Mobile Services." Information Systems and New Applications in the Service Sector: Models and Methods: Models and Methods, pp. 15, 2010.
[22] G. Wei-Han Tan, S. Jia-Jia, O. Keng-Boon and K. Phusavat, "Determinants of Mobile Learning Adoption: An Empirical Analysis", Journal of Computer Information Systems, vol.52, no.3, pp.82-91, 2012.
[23] V. Terzis, C. N. Moridis, A.A. Economides and G. Rebolledo-Mendez, "Computer Based Assessment Acceptance: A Cross-cultural Study in Greece and Mexico", Educational Technology& Society, vol.16, no.3, pp. 411–424, 2013.
[24] A. Harchay, L. Cheniti-Belcadhi and R. Braham, "A Context-Aware Framework to Provide Personalized Mobile Assessment", International Journal on Interaction Design & Architecture(s), Special issue on : "The Design of TeLwith Evidence and Users", pp. 82-97, April 2015.
[25] A. Harchay, L. Cheniti-Belcadhi and R. Braham, "Towards a Formal Description of Mobile Personalized Assessment", The Second International Conference on Communications and Information Technology (ICCIT), pp.270 – 275, 2012.
[26] A. Harchay, L. Cheniti-Belcadhi and R. Braham, "A Model Driven Infrastructure for Context-Awareness Mobile Assessment Personalization", 11th IEEE International Conference on Trust, Security and Privacy in Computing and Communications, TrustCom 2012.
[27] A. Harchay, L. Cheniti-Belcadhi and R. Braham, "Retrieval and Personalization of Mobile Assessment in the Semantic Web", International Conference on Engineering Education and Research, ICEER 2013.
[28] E. L. Deciet and R. M. Ryan, "Handbook of self-determination research", Rochester, NY: University of Rochester Press.
[29] T.L. Ju, W. Sriprapaipong and D.N. Minh, "On the success factors of mobile learning", Paper presented at 5th International Conference on ICT and Higher Education, Bangkok, 2007.
[30] S. Iqbal and I. A. Quereshi, "M-learning adoption: A perspective from a developing country", The International Review of Research in Open and Distance Learning, vol.13, no.3, pp.147–164, 2012.
[31] A. Martınez, Y. Dimitriadis, B. Rubia, E. Gómez and P. De La Fuente, "Combining qualitative evaluation and social network analysis for the study of classroom social interactions", Computers & Education, vol.41, no.4, pp.353-368, 2003.
[32] M. Pérez-Sanagustín, P. J. Muñoz-Merino, C. Alario-Hoyos, X. Soldani, C. D. Kloos, "Lessons learned from the design of situated learning environments to support collaborative knowledge construction", Computers & Education, vol.87, pp.70-82, 2015.
[33] J. C. Roca and M. Gagné, "Understanding e-learning continuance intention in the workplace: A self-determination theory perspective", Computers in Human Behavior, vol. 24, no. 4, pp.1585–1604, 2008.
[34] O. Sorebo, H. Halvari, V. F. Gulli and R. Kristiansen, "The role of self-determination theory in explaining teachers' motivation to continue to use e-learning technology", Computers & Education, vol.53, no.4, pp.1177–1187, 2009.
[35] D. Barclay, C. Higgins, and R. Thompson, "The Partial Least Squares Approach to Causal Modeling, Personal Computing Adoption and Use as an Illustration", Technology Studies, vol.2, no.2, pp.285–309, 1995.
[36] W.W. Chin, "Issues and Opinions on Structural Equation Modeling", MIS Quarterly vol.22, no.1, pp.7–16, 1998.
[37] C. M Ringle, S. Wende and J.M. Becker, SmartPLS 3. SmartPLS, "Available at: Hamburg : http://www.smartpls.de/", last accessed September 2019.
[38] B. H. Wixon and H. J. Watson, "An empirical investigation of the factors affecting data warehousing success", MIS Quarterly, vol.25, no.1, pp.17–41, 2001.

[39] IMS/QTI, "Ims question test interoperability specification, http://www.imsglobal.org/question/index.html", last accessed September 2019.
[40] S. Nikou and A.A. Economides, "The impact of paper-based, computer-based and mobile-based self-assessment on students' science motivation and achievement", Computers in Human Behavior 55, pp.1241–1248, 2016.
[41] S. Nikou and A.A. Economides, "Mobile-Based Assessment: Integrating acceptance and motivational factors into a combined model of Self-Determination Theory and Technology Acceptance", Computers in Human Behavior 68, pp.83-9, 2017.
[42] S. Nikou and A.A. Economides, "Mobile-based assessment: Investigating the factors that influence behavioral intention to use", Computers & Education 109, pp56-pp73, 2017

Appendix A

Constructs	Items	
Perceived Autonomy	**A1**	I feel ready to use mobile self-assessment for learning.
	A2	There are many opportunities for deciding to use mobile self-assessment for learning.
	A3	I feel pressured at using mobile self-assessment in my learning.
	A4	I am free to express my ideas and opinions on using mobile self-assessment in my educational work.
Perceived Competency	**C1**	Mobile self-assessment enhances learning activities.
	C2	I acquire new competences when I adopt mobile self-assessment.
	C3	I have confidence to adopt the mobile self-assessment to improve learning activities.
	C4	I can improve my competences by adopting mobile self-assessment.
Perceived Relatedness	**R1**	People that affect my learning (teachers/tutors) think that I should adopt mobile self-assessment.
	R2	My colleagues think that I had to use mobile self-assessment.
	R3	Overall, mobile self-assessment allows better collaboration and cooperative learning.
Perceived Usefulness	**PU1**	Mobile self-assessment improves the quality of my learning.
	PU2	Using mobile self-assessment enhances my effectiveness of my learning.
	PU3	Overall, mobile self-assessment is useful in my learning activity.
Perceived Ease of Use	**PEOU1**	It is easy for me to adopt mobile self-assessment for my learning.
	PEOU2	It is easy for me to become skillful at using mobile device for self-assessment.
	PEOU3	I can at any time and at any place to adopt mobile self-assessment for learning.
Perceived Attitudes Towards Use	**ATU1**	I think that I'll use mobile self-assessment as an assessment method for my learning.
	ATU2	Overall, I consider mobile self-assessment a good method to assess my learning.
	ATU3	In my academic career, mobile self-assessment use would be ideal.
Perceived Intention to Use	**ITU1**	I'm motivated to use mobile self-assessment in the future.
	ITU2	If necessary, I would use the mobile self-assessment often for my learning.
	ITU3	My intention is to use mobile self-assessment for my learning rather than using other assessment methods (pencil-paper and web-based assessment methods).
	ITU4	For my academic cursus, I'm ready to use mobile self-assessment for learning.