Acceptance of Mobile-Based Assessment from the perspective of Self-Determination Theory of Motivation

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***Abstract*— Mobile-based assessment offers a promising (complementary to paper-based and computer-based) assessment delivery mode. However, its successful implementation depends on users' acceptance. The present study is the first towards the investigation of the factors that influence the acceptance of mobile-based assessment. It combines two theoretical frameworks: Technology Acceptance Model and Self-Determination Theory of Motivation. Partial Least Squares were used to test the proposed structural model. 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.**

Keywords - mobile computing, educational technology, mobile-based assessment, technology acceptance model, self-determination theory

I. INTRODUCTION

Mobile learning is a relatively new field in education. The increasing and diverse functionalities that mobile devices offer, their low cost and widespread availability among students as well as the advances in wireless technologies are the primary drivers for mobile learning [1]. Mobile technologies can facilitate learning "anytime and anyplace", offering a continuous learning experience that is personal, situated and contextual [2]. All educational processes, including assessment, can be facilitated even revitalized through mobile technologies. Different assessment practices can be implemented with the use of mobile devices: adaptive, dynamic, location-aware, context-aware, collaborative, self- and peer-assessment even mobile game-based assessment [3]. Mobile assessment can unfold its full potential when it is administered in authentic learning environments, such as parks, museums or other sites, outside the physical boundaries of a classroom or a lecture hall. However, mobile assessment can also take place inside the boundaries of a classroom or a large lecture class. Students can use their own mobile devices (BYOD - "Bring Your Own Device") to access class material and answer teacher questions (e.g. classroom response systems). This practice eliminates the need for desktop computers facilitating the implementation of the one-to-one initiative. It promotes the interactivity among teacher and students and enhances student participation and engagement [4]. Although mobile technologies offer new potentials in learning and assessment, success is not guaranteed by itself. The effective implementation of any Information Technology (IT) system depends on user acceptance. There are numerous studies examining the acceptance of computer based assessment [5, 6]. Also, the research for the investigation of the acceptance of mobile learning is still evolving [7, 8, 9]. However, there is a gap in the literature regarding Mobile-Based Assessment (MBA) acceptance. It is necessary to investigate the factors that influence MBA adoption in order to further develop and improve this new delivery mode of assessment. To our knowledge, the present study is the first attempt to model the acceptance of mobile-based assessment. We start with a short presentation of the related theoretical background. Then we present our proposed acceptance model and our hypotheses. We proceed with our methodology, data analysis and results. Finally, discussions as well as model limitations and future research are presented.

II. BACKGROUND

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. Mobile based assessment is in its infancy. In order for mobile-based assessment to be successfully implemented from educational institutions, investigating its adoption from students is an essential issue.

A. Technology Acceptance Model (TAM)

Acceptance and usage of new technologies have been studied extensively. One major model in the field of IT acceptance is the Technology Acceptance Model (TAM) [10]. TAM uses Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Attitudes Towards Usage (ATU) to explain and predict system adoption. Perceived Usefulness is defined as the degree to which a person believes that using a

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particular system will enhance his/her job performance and Perceived Ease of Use is defined as the degree to which a person believes that using the system would be free of effort [10]. Both PU and PEOU influence the Attitudes Towards Usage (ATU) which in turn influences the Behavioral Intention to Use the system (BIU) and the actual system use (Fig. 1). Since its first invention, many external variables have been added to TAM in order to explain the acceptance and intention to use IT systems. Motivation, the driving force towards an action, has been found to have a sound impact on behavioral intention to ICT usage [11, 12].

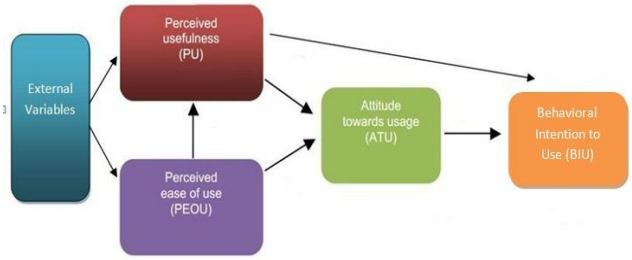

Figure 1.Technology Acceptance Model (TAM)

B. *Self-Determination Theory of Motivation (SDT)*

Among motivation theories, Self-Determination Theory (SDT) [13] is a well-established and empirically well-supported theory of motivation. It distinguishes two types of motivation. Intrinsic motivation refers to doing something for its own sake and extrinsic motivation refers to doing something for a consequence external to the activity itself. With the process of internalization, two types of extrinsic motivation, namely identified regulation and integrated regulation, can be transformed from extrinsic types into personally endorsed values. The theory is concerned with the support of self-determined types of motivation (intrinsic motivation and identified regulation) that lead to satisfaction and better performance. According to the theory, a basic set of psychological needs must be satisfied in order to enhance intrinsic motivation. These needs are autonomy, competence and relatedness. Autonomy refers to the desire to self-initiate and self-regulate own behavior. Relatedness refers to the desire to feel connected to others. Competence refers to the desire to feel effective in attaining valued outcomes [14]. Self-determination theory has been used in the educational field also. If these basic psychological needs are supported in the classroom, students are more likely to internalize their motivation to learn and to be more autonomously engaged in their studies [15]. Teachers and instructional designers need to develop learning environments that are intrinsically motivating. The same holds for assessment delivery modes.

C. *TAM and SDT*

Self-Determination Theory of motivation along with the Technology Acceptance Model has already been used to explain the relation between motivation and intention to continue use e-learning. Roca and Gagne [16] complemented TAM with SDT to understand e-learning continuance intention in a work setting from the student perspective. Sorebo et al. [17] examined the effects of the SDT constructs on teachers' intention to continue use on-site courses. The present study builds on the above two theoretical frameworks i.e. SDT and TAM, focusing on students' Attitudes Towards the Use of mobile-based assessment. It utilizes self-determination theory of motivation to investigate the underlying motivational factors that trigger the TAM constructs (PU, PEOU, ATU) towards students' Behavioral Intention to Use mobile-based assessment. Its aim is to explain and predict motivational factors towards mobile assessment system adoption form the SDT perspective.

III. RESEARCH MODEL AND HYPOTHESES

Our model is based on SDT and TAM and proposes that perceived autonomy, perceived competence and perceived relatedness have a positive effect on perceived usefulness, perceived ease of use and attitudes towards usage mobile based assessment, which in turn have a positive effect on behavioral intention to use MBA. (Fig. 2)

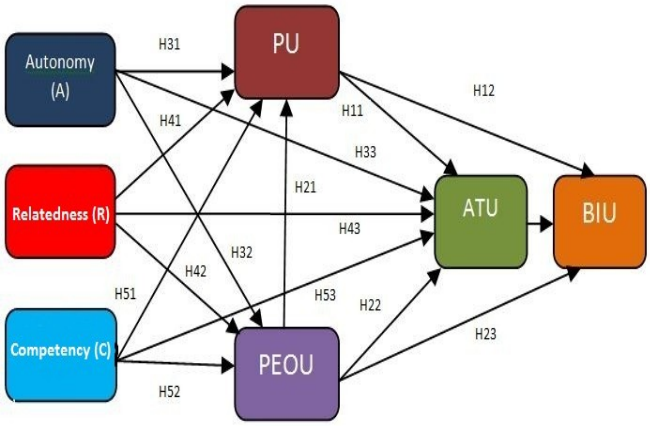

Figure 2. Conceptual model

Previous research in the context of mobile learning acceptance has shown significant relationships among PEOU, PU and ATU towards BIU [18, 8, 19]. The same holds for computer based assessment acceptance [5, 20]. Therefore, in our model about mobile based assessment we propose the following hypotheses:

H1*:* Perceived Usefulness (PU) will have a positive effect on ATU (H11) and BIU (H12).

H2*:* Perceived Ease of Use (PEOU) will have a positive effect on PU (H21), ATU (H22) and BIU (H23).

Students in mobile learning may require which learning activities they wish to engage in. They also have a strong sense of device ownership that may be transformed to learning ownership. Students' control over their own goals

and the sense of ownership they experience, are among motivating factors in the context of mobile learning [21]. The self regulation that students and test-takers experience in the context of mobile learning and assessment can be conceptualized as autonomy. Students may be able to initiate and perform the assessment procedure anytime and anyplace they want, transforming even external regulations (teacher generated assessments) into self-regulation. In line with Self-Determination Theory we predict that:

H3*:* Perceived Autonomy (A) will have a positive effect on PU (H31), PEOU (H32) and ATU (H33).

In the Information Systems domain, Perceived Relatedness can be considered as a form of social influence (subjective norm). Previous technology acceptance studies have found associations between social influence and other system acceptance constructs [22]. We hypothesize:

H4*:* Perceived Relatedness (R) will have a positive effect on PU (H41), PEOU (H42) and ATU (H43).

Previous studies have shown connection between computer self-efficacy and perceived usefulness and ease of use [23, 24]. The reported level of self-efficacy in our study was high enough. The perceived competence level influences students' motivation to participate in the MBA, therefore we hypothesize:

H5*:* Perceived Competency (C) will have a positive effect on PU (H51), PEOU (H52) and ATU (H53).

IV. METHODOLOGY

The participants in this study were 167 first-year undergraduate students, enrolled in an introductory informatics course, in the Department of Economic Sciences of a European University. There were 91 males (54%) and 76 females (46%). The average age of students was 18.6 (SD = 1.04). The median mobile self-efficacy score was 70 on a scale of 100 (the questionnaire adopted from [25]), indicating that students were confident enough to use their mobile devices in the assessment. The use of the MBA was voluntary.

The mobile devices used were wi-fi enabled smartphones (79% Android, 15% iOS 5%, Windows Phone and 1% other). The 30 min duration mobile-based assessment consisted of 30 multiple choice questions with four possible answers each. The student had to click on the right answer for each question and move on to the next page. The interface was kept as simple as possible to avoid possible destructions.

In order to examine the seven latent constructs of our proposed model, we employed a measurement instrument consisted of 21 items adopted from previous studies about acceptance and motivation. For Perceived Usefulness, Perceived ease of Use, Attitudes Towards Using and Behavioral Intention to Use we used items from [10]. For Perceived Autonomy, Perceived Relatedness and Perceived Competency we adopted items from [16, 17] appropriately modified for the current context of mobile-based assessment. All items were measured on a seven point Likert-type scale with 1 corresponding to "strongly disagree" and 7 to "strongly agree".

V. DATA ANALYSIS

Partial Least-Squares (PLS) with Smart PLS 2.0 [26] was used as the analysis technique to predict factors influencing mobile-based assessment adoption.

Table I along with descriptive statistics, reports the quality of the measurement model with factor loading of each item measure (> 0.7), Cronbach a (> 0.7) and composite reliability of each construct (> 0.7) as well as average variance extracted (AVE > 0.5), confirming convergent validity.

TABLE I. CONVERGENT VALIDITY OF THE MODEL

Construct Item	Mean (SD)	Factor Loading (>0.7) [a]	Cronbach a (>0.7) [a]	Composite Reliability (>0.7)[a]	AVE (>0.5)[a]
A	5.90 (1.57)		0.858	0.913	0.779
A1		0.749			
A2		0.886			
A3		0.831			
BIU	5.74 (1.61)		0.918	0.961	0.925
BIU1		0.755			
BIU2		0.780			
BIU3		0.992			
C	5.40 (1.40)		0.828	0.920	0.858
C1		0.793			
C2		0.824			
C3		0.701			
ATU	4.83 (1.04)		0.958	0.973	0.923
ATU1		0.957			
ATU2		0.920			
ATU3		0.932			
PEOU	5.19 (1.57)		0.898	0.933	0.823
PEOU1		0.898			
PEOU2		0.920			
PEOU3		0.906			
PU	5.14 (1.22)		0.714	0.793	0.563
PU1		0.702			
PU2		0.869			
PU3		0.880			
R	5.45 (1.29)		0.754	0.817	0.602
R1		0.934			
R2		0.930			
R3		0.711			

a. Indicates an acceptable level of reliability and validity

Tables II reports the square root of the average variance extracted of each construct (the diagonal elements) to be higher than any correlations with another construct, verifying discriminant validity.

TABLE II. DISCRIMINANT VALIDITY OF THE MODEL

Construct	A	BIU	C	ATU	PE OU	PU	R
A	**0.88**						
BIU	0.51	**0.96**					
C	0.68	0.39	**0.92**				
ATU	0.56	0.88	0.44	**0.96**			
PEOU	0.50	0.65	0.47	0.62	**0.91**		
PU	0.42	0.65	0.23	0.60	0.63	**0.75**	
R	0.46	0.50	0.37	0.43	0.42	0.43	**0.78**

Bold values: the square root of the average variance extracted (AVE) of each construct.

We found support for eleven out of fifteen hypotheses in our proposed model. Table III shows the hypothesis testing results.

TABLE III. HYPOTHESIS TESTING RESULTS

H	Path	Path coefficient	t statistics	support
H33	A -> ATU	0.149 **	1.981	yes
H32	A -> PEOU	0.282 **	2.345	yes
H31	A -> PU	0.213 ***	2.574	yes
H43	R -> ATU	0.211 ***	2.768	yes
H42	R -> PEOU	0.216 **	2.238	yes
H41	R -> PU	0.195 ***	2.754	yes
H53	C -> ATU	0.061	0.861	no
H52	C -> PEOU	0.195	1.786	no
H51	C -> PU	0.195 **	2.531	yes
H10	ATU -> BIU	0.756 ***	3.319	yes
H12	PU -> BIU	0.083	1.314	no
H11	PU -> ATU	0.432 ***	5.428	yes
H23	PEOU -> BIU	0.128 **	2.459	yes
H22	PEOU -> ATU	0.129	1.518	no
H21	PEOU -> PU	0.553 ***	7.344	yes

*p<0.1, **p<0.05,***p<0.01.

Our findings suggest:

- Attitudes towards use is attributed to Perceived Autonomy, Perceived Relatedness and Perceived Usefulness.
- Perceived Usefulness is attributed to Perceived Autonomy, Perceived Relatedness, Perceived Competency and Perceived Ease of Use.
- Perceived Ease of Use is attributed to Perceived Autonomy and Perceived Relatedness.
- Behavioral 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 R^2 values.

The calculated R^2 values and the significance of the path coefficients as well as the t-values and total effects calculated with a bootstrapping procedure are the criteria used to assess our structural model and its hypotheses.

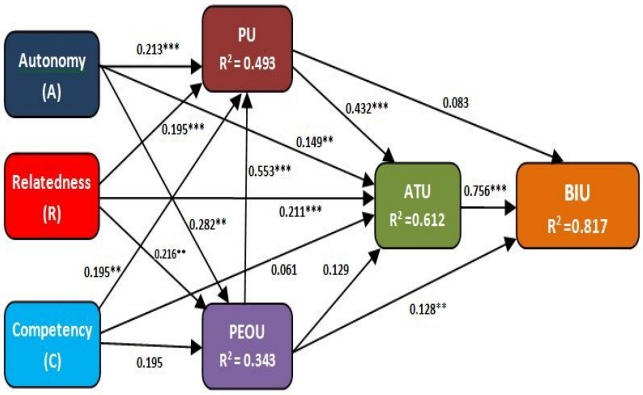

Figure 3. Result of the structural model: TAM extended with SDT

The model explains about 82% (R^2 =0.817) of the variance in Behavioral Intention to Use. The study demonstrated that students have a strong Behavioral Intention to Use the mobile-based assessment. The total effects of ATU (0.756), PEOU (0.452), PU (0.409), A (0.282), C (0.189) and R (0.288) on BIOU are adequately strong to explain the Behavioral Intention to Use. Furthermore, PU (0.432), R (0.374), PEOU (0.368), C (0.171) and A (0.348) explain 61% (R^2=0.612) of the variance in Attitudes towards Usage. Also, A (0.320), PEOU (0.553), C (0.324) and R (0.314) explain 49% (R^2=0.493) of the variance in Perceive Usefulness. Finally, C (0.195), A (0. 282) and R (0.216) explain 34% (R^2=0.343) of the variance in Perceived Ease of Use.

VI. DISCUSSION AND FUTURE RESEARCH

Previous studies have successfully applied the TAM model in the context of e-learning and m-learning. This is the first study investigating the factors that influence the behavioral intention to use a mobile-based assessment from the combined perspective of Self-Determination Theory of Motivation and the Technology Acceptance Model.

We have found that two of the Self-Determination Theory constructs, namely Perceived Autonomy and Perceived Relatedness along with Perceived Usefulness from TAM are important in explaining students' Attitudes Towards Using the mobile-based assessment. Autonomy and Relatedness have a positive impact on Perceived Ease of Use also. In the present study, Competency has not been found to significantly affect neither Attitudes towards Use nor Perceived Ease of Use. However all three SDT variables plus Perceived Ease of Use significantly influence Perceived Usefulness. Finally, Attitudes Towards Use and Perceived Ease of Use significantly affect Behavioral Intention to Use MBA, which is in accordance with previous technology acceptance research.

The implications are that when students' basic psychological needs are satisfied, then their level of motivation to use mobile-based assessment increases. When student autonomy and self-regulation is supported and there is a positive social influence, students feel more motivated to participate in the MBA. They also consider MBA an easier and useful task. Practitioners should take this into consideration when they design and implement mobile-based assessments.

Mobile-based assessment offers a promising (complementary to paper-based and computer-based) assessment delivery mode that can be implemented either inside classroom boundaries or "on the go". The satisfaction of the basic psychological needs that mobile-based assessment offers is a motivating factor to accept and use the system. By explaining MBA acceptance from the SDT perspective, we could improve MBA by adapting it to the student specific motivational needs. Policy makers, education administration and educators should design and implement more motivating assessments. More motivating examinees may exhibit better learning achievements.

Since the present study is a first attempt for the development of a MBA acceptance, it has some limitations. Additional variables (capturing other mobile learning features) need to be added to the proposed model. The study could be applied also to different group of students (major, culture, age). In our future research we will expand our model and apply it in other educational settings as well.

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