THE TECHNOLOGY ACCEPTANCE OF MOBILE APPLICATIONS IN EDUCATION[1]

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ABSTRACT

This research explores the educators' attitudes and behavioural intention toward mobile applications. The methodology integrates measures from 'the pace of technological innovativeness' and the 'technology acceptance model' to understand the rationale for further investment in mobile learning (m-learning). A quantitative study was carried out amongst two hundred forty-one educators in small EU state. It has investigated the costs and benefits of using ubiquitous resources, including tablets for m-learning in schools. A principal component analysis has indicated that the educators were committed to using mobile technologies. In addition, a stepwise regression analysis has shown that the younger teachers were increasingly engaging in m-learning resources. In conclusion, this contribution puts forward key implications for both academia and practitioners.

KEYWORDS

Mobile, Mobile Learning, Technology Acceptance Model, Technology Innovation Principal Component Analysis, Stepwise Regression Analysis.

1. INTRODUCTION

Innovative technologies may have brought powerful, transformative tools which are improving on our quality of lives (Fullan, 2013; Prensky, 2005). Stakeholders in education are also promoting innovative pedagogical practices by using technology (Fullan, 2013); as students from a tender age are acquiring 'digital skills' and expertise in media and information communication technologies (ICT). Many pupils operate offline specialised software as well as online programmes on internet (Castaño-Muñoz, Duart & Sancho-Vinuesa, 2014; Tyner, 2014). ICT has improved their ways of accessing knowledge, researching, communicating, socialising and succeeding in all levels of education (Hoskins & Crick, 2010; Smith, Higgins, Wall & Miller, 2005). Nowadays, many children and teenagers can easily access a personal computer at home or at school. Many of them are also using their own wireless devices, including smart phones and tablets for many purposes (Sampson, Isaias, Ifenthaler, & Spector, 2012; Sharples, Arnedillo-Sánchez, Milrad & Vavoula, 2009). Hence, educators ought to respond to these new realities as they need to adapt their teaching designs and methodologies to better respond to today's students' abilities, interests and learning styles (Sánchez & Isaías, 2014).

The students' use of digital and mobile media during lessons is related to the teachers' confidence level in their digital competences (Bocconi, Kampylis & Punie, 2013). Inevitably, students are affected by the teachers' stance toward technologies in education. The pupils' motivation for learning may also be correlated to the access and availability of innovative learning resources, including mobile games in school environments (Sardone & Devlin-Scherer, 2010). The EU (2013) has underlined the importance of high access to ICT infrastructure at school; as its survey reported that between 20-25% of European students are taught by digitally competent teachers who have high access to ICT. Academic evidence also shows that increasing professional development opportunities for teachers is an efficient way of boosting technology acceptance in teaching and learning, since it helps build highly confident and supportive teachers (Sampson et al., 2012; Sharples et al., 2009).

The use of digital learning resources requires ongoing support – not only technical but also pedagogical (Fullan, 2013; EU, 2013). Ongoing training and continuous professional development ought to be provided by school staff and others to teachers of all disciplines, including subject-specific training on learning applications (Spector, Ifenthaler, Sampson & Isaías, 2016). Confident and supportive teachers are highly required to effectively use educational technologies including ubiquitous mobile applications to exploit their potential (Sánchez & Isaías, 2014; Martin & Ertzberger, 2013). In this light, this paper explores the educators' attitudes toward technology in education. It unfolds their motivations behind their use of mobile learning technologies (Sánchez & Isaías, 2014; Arrigo, Kukulska-Hulme, Arnedillo-Sánchez & Kismihok, 2013; Sardone & Devlin-Scherer, 2010).

1.1 Aims and Objectives

This paper makes use of previous tried and tested measures, namely; 'the pace of technological innovativeness' (De Smet, Bourgonjon, De Wever, Schellens & Valcke, 2012; Grewal, Mehta & Kardes, 2004); 'technology acceptance' (Cheon, Lee, Crooks & Song, 2012; Huang, Huang, Huang & Lin, 2012; Davis, 1989); and 'technology anxiety' (Celik & Yesilyurt, 2013; Camilleri & Camilleri, 2017); Meuter, Bitner, Ostrom & Brown, 2005) as it investigates the educators' attitudes for (or against) mobile learning resources.

This research was principally guided by the following research question: 'How do factors such as 'technology acceptance' (Davis, 1989); 'pace of technological innovativeness' (Grewal et al., 2004) and 'technology anxiety' (Meuter et al., 2005) affect the educators' attitudes towards the use of mobile learning resources in-class? Therefore, the intention of this project was to advance theory on the subject of technologies in education and to put forward the empirical findings in the field of 'mobile learning'. A quantitative study explored the educators' perceptions about the use and the ease of use of the latest mobile applications in a primary educational setting. Hence, a multivariate regression analysis has investigated the relationships between 'the pace of technological innovativeness', 'the perceived ease of use of technology' and 'the perceived usefulness of technology' as well as 'technology anxiety'. At the same time, this empirical study has considered whether socio-demographic variables affected these correlations. The over-arching aim of this research project was to identify and to analyse the determinants which explain why educators are (or are not) engaging themselves mobile-learning technologies. This research project was built on the foundation of the following research questions:

- What are the educator's attitudes toward mobile learning resources in education?
- Are they actively using (or avoiding) mobile learning resources including educational applications on tablets in their classrooms?

1.2 Research Setting
One of the priority areas for the first cycle of the strategic framework for education and training ('ET 2020') is the promotion of creativity and innovation through the use of new ICT tools and teacher training (EU, 2013). ICT transforms teaching and learning as it contributes to the acquisition of basic or key competences. In this day and age, it is imperative that students achieve digital fluency (Smith et al., 2005). Digital skills and ICT competences are a pre-requisite for employment, personal fulfilment, social inclusion and active citizenship in

today's rapidly-changing world (Hoskins & Crick, 2010). In a sense, education institutions are there to help their students develop competences. From a tender age, schools teach their pupils to be analytical and reflexive. Students are taught how to work autonomously as well as collaboratively. They learn how to seek information and support as they make use of new resources and technologies (Fullan, 2013). National education policy makers have articulated specific policies to use ICT in teaching and learning (EU2013). These authorities have implemented support measures to increase the frequency of students' ICT-based activities for learning in the classroom.

The EU (2013) survey indicated that the schools that had specific policies about ICT integration in teaching and learning experienced the highest frequency of the use of digital learning resources (DLRs) and ICT learning based activities. Furthermore, the report suggested that these schools implemented support measures including teacher professional development and also sought the provision of ICT coordinators. Interestingly, students who attended schools with focused ICT policies were more engaged in DLRs when compared to other students who hailed from schools with no ICT policies or support measures. The European Union member state have set national strategies covering training measures for ICT in schools, digital / media literacy and e -skills development,training and research projects in e-learning, and research projects in e-inclusion (European Schoolnet, 2012b). There are central steering documents for all ICT learning objectives at secondary education level and for using a computer, using office applications, searching for information, and using multimedia at primary level (European Schoolnet, 2012). ICT is taught as a general tool for other subjects / or as a tool for specific tasks in other subjects. In addition, ICT is taught as a separate subject in secondary schools. Recommendations and support is provided to all primary and secondary schools in all ICT hardware areas, except for mobile devices and e-book readers, and for all ICT software categories.

According to official steering documents, both students and teachers at primary and secondary level are expected to use ICT in all subjects both in class and for complementary activities, except for in foreign languages at primary level where it is used only for complementary activities (European Schoolnet, 2012). There are no central recommendations on the use of ICT in student assessment. Public-private partnerships are increasingly promoting the use of ICT as they are encouraged to use digital technologies.

2. KEY CONCEPTS AND THE FORMULATION OF HYPOTHESES

Relevant literature suggest that educational institutions are inevitably influenced by the latest advances in technology on teaching and learning. Fullan (2013) held that educators should embrace technologies and apply them in meaningful ways to positively impact students. He went on to suggest that a "new pedagogy" of higher-order skills that focuses on the harnessing of fast and innovative technologies can bring about change in the right direction (for the delivery of student-centred education).

2.1 Pace of Technological Innovativeness

The educators' personal insights and perceptions of mobile learning resources may affect the frequency of how students' engage themselves in education. Garcia and Calantone (2002) maintained that the innovation process comprises the technological development of an invention combined with the market introduction of that invention to end users through adoption and diffusion. They claimed that the pace of technological innovativeness is 'iterative' as it involves continuous engagement with new emerging innovations. Therefore, the schools should remain up-to-date with the latest ICT infrastructure (EU, 2013; Greenhow & Robelia, 2009). Continuous professional development and ongoing training is a prerequisite for an effective and efficient use of ICT infrastructure and digital (and mobile) learning resources (Camilleri & Camilleri, 2016; Wastiau, Blamire, Kearney, Quittre, Van de Gaer & Monseur, 2013; Prensky, 2005). This leads to the first hypothesis:

    i.   There is a relationship between 'the pace of technological innovation' in schools and 'the technological acceptance' of educators.

2.2 The Technology Acceptance Model and Technological Anxiety

The technological acceptance model has often investigated the respondents' behavioural intention to use technology (Davis, 1989; Davis, Bagozzi & Warshaw, 1989). This purported model has explained the causal relationship(s) between the users' internal beliefs, attitudes, intentions and computer usage behaviours. In the past, the technological acceptance model sought to explain why people accepted or rejected a particular technology (Mac Callum & Jeffrey, 2014; Davis, 1989). Therefore, the technological acceptance model has been chosen for this research to find out why educators used (or avoided) mobile learning resources. Davis (1989) suggested that perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance. From the outset, the researchers presumed that the respondents would perceive both the usefulness and would probably indicate their ease of use of mobile learning resources in their classroom environments (Sánchez & Isaías, 2014; Arrigo et al., 2013).

Notwithstanding, Davis (1989) explained that the perceived ease of use (PEOU) was "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Davis (1989) held that the usage of technology is influenced by its perceived ease of use. In this case, the researchers investigated whether the educators at St Clare's College were (or were not) proficient in the use of mobile learning technologies. Although potential users could believe that a given technology is useful, they may, at the same time be against (for some reason) its use in their classroom. They may perceive that there aren't sufficient performance benefits for using mobile learning technologies (Sampson et al., 2012; Meuter et al., 2005; Garcia & Calantone, 2002). This leads to the second and third hypotheses:

ii.   There is a positive relationship between perceived usefulness and the perceived ease of use of digital learning resources. (This hypothesis investigates the technological acceptance model).

iii. This empirical study will also investigate the causal relationships (by using stepwise regression) between perceived usefulness, perceived ease of use, the pace of technological innovativeness and technological anxiety.

3. THE METHODOLOGY

This study has targeted all members of staff including heads, assistant heads, teachers and learning support assistants in eleven schools at St Clare's College in Malta, Europe. The survey's responses were presented as a five-point likert scaling mechanism. Their values ranged from 1 (strongly disagree) to 5 (strongly agree) with 3 signalling indecision. After filtering and eliminating the incomplete survey observations, a total of 241 valid responses were obtained. Reliability and appropriate validity tests have been carried out during the analytical process. Cronbach's alpha was calculated to test for the level of consistency among the items. There was an acceptable level of reliability for this study; as Alpha was always more than the 0.7 threshold.

3.1 The Measures

The researcher has adapted six items from the 'pace of technological innovation'; that intended to measure the educators' attitudes toward the unprecedented pace of technological advances in m-learning resources. Originally, this scale has reported a construct reliability of 0.97 (Grewal et al., 2004) and had used confirmatory factor analysis to provide evidence to support the scales' convergent and discriminant validities.

In previous studies, the technological acceptance model has played an important role in evaluating the users' perceptions on their ease of use, their perceived usefulness and behavioural intention toward technology. Davis's (1989) six items that represented 'perceived usefulness' attained a constructed reliability of 0.97, while the six items about 'perceived ease of use' had a reliability of 0.91. The technology acceptance measures were acceptable as their factor loadings were reported to be significant and there was evidence of discriminant validity for each construct (Davis, 1989).

Another four items that were used to measure the degree to which educators were apprehensive, or for some reason rejected the usage of mobile learning resources (Mac Callum & Jeffrey, 2014; Meuter et al., 2005).

These items were also similar to the computer anxiety scale that were used by Celik & Yesilyurt (2013). Meuter et al. (2005) reported an alpha of 0.93 for these items. Their measurement model was acceptable as the factor loadings were significant and there was evidence of discriminant validity for each construct using different tests (confidence interval and variance extracted).

4. ANALYSIS

There were twenty one males (9%) and two hundred twenty females (91%) (n=241). Again, the respondents' 'age' varied, and this was evident in the standard deviation of 0.70. Respondents were also classified into five age groups (16-25; 26-35; 36-45; 46-55 and 56-65). The majority of the respondents were aged between 36 and 45 years of age (37%, n=89), followed by those aged between 26 and 35 years (26%, n=62). The designation / 'role' of the respondents taking part in this study consisted of heads (4.1%, n=10), assistant heads (5.4%, n=13), teachers (71.4%, n=172), instructors (5%, n=12), facilitators (7.9%, n=19) and kindergarten assistants (6.2%, n=15). All the respondents were full time educators and held an indefinite engagement contract with the Ministry of Education and Employment in Malta. The respondents' mean work experience within the education sector' was approximately fifteen years. The responses ranged from a minimum of a year to a maximum of thirty-one years of relevant industry experience. The majority of respondents indicated that they attended tertiary education (85.1%, n=205). Whereas, twenty-four respondents (9.9%) attended vocational institutions and twelve individuals (5%) indicated that they completed the secondary 'level of education'.

This study is consistent with the extant literature on the technology acceptance model' (Cheon et al., 2012; Huang et al., 2012; Davis, 1989; Davis et al., 1989) as there were high mean scores of near 4, which reflected the educators' stance on mobile learning resources. Moreover, the respondents have conveyed their strong agreement with the 'pace of technological innovativeness' (De Smet et al., 2012; Grewal et al., 2004). The educators suggested that learning technologies are changing fast, as the mean score was of 4.05 and there was a standard deviation of 0.47.

4.1 Data Reduction

The Kaiser Meyer Olkin (KMO) measure of sampling adequacy was acceptable at 0.9. Bartlett's test of sphericity also revealed sufficient correlation in the dataset to run a principal component analysis (PCA) since $p < 0.001$. The principal component analysis (PCA) has been chosen to obtain a factor solution of a smaller set of salient variables, from a much larger dataset. A varimax rotation method was used to spread the variability amongst the constructs. PCA was considered appropriate as there were variables exhibiting an underlying structure. Many variables shared close similarities as there were highly significant correlations. Therefore, PCA has identified the patterns within the data and expressed it by highlighting the relevant similarities (and differences) in each component. In the process, the data has been compressed as it was reduced in a number of dimensions without much loss of information. PCA has produced a table which illustrated the amount of variance in the original variables (with their respective initial eigenvalues) which were accounted for by each component. There was also a percentage of variance column which indicated the expressed ratio, as a percentage of the total variance. A brief description of the extracted factor components, together with their eigenvalue and their respective percentage of variance is provided hereunder in Table 1. With respect to scale reliability, all constructs were analysed for internal consistency by using Cronbach's alpha. The composite reliability's coefficient were well above the minimum acceptance value of 0.7 (Bagozzi, & Yi, 1988).

Table 1. The Extracted Factor Components

Factor Component	Initial Eigenvalues	% of Variance	Extraction Sums of Squared Loadings	% of Variance	Rotation Sums of Squared Loadings	% of Variance
1 Perceived Usefulness of DLR	5.533	25.152	5.533	25.152	4.04	18.362
2 Pace of Technological Innovation	2.378	10.809	2.378	10.809	2.555	11.613
3 Technological Anxiety	1.846	8.391	1.846	8.391	2.27	10.319
4 Easy Interaction with DLR	1.662	7.553	1.662	7.553	1.711	7.776
5 Perceived Ease of Use of DLR	1.192	5.418	1.192	5.418	1.681	7.642
6 Effective DLR	1.119	5.085	1.119	5.085	1.473	6.695

The sum of the eigenvalues equalled the number of components. Only principal components with eigenvalues greater than 1 were extracted. The factors accounted for more than 62% variance before rotation. There were six extracted components from twenty-two variables. The factor components were labelled following a cross-examination of the variables with the higher loadings. Typically, the variables with the highest correlation scores had mostly contributed towards the make-up of the respective component. The underlying scope of combining the variables by using component analysis was to reduce the data and make it more adaptable for regression analysis.

4.2 Multivariate Regression

A stepwise procedure was purposely carried out to select the most relevant predictive variables in the regression models. The p-value was less than the 0.05 benchmark. There were adequate F-ratios, implying that the significant amounts of variation in regression were accounted for. More importantly, in the stepwise procedure the insignificant variables were excluded without appreciably increasing the residual sum of squares (Field, 2009). The regression models produced the regression coefficients which represented the strength and significance of the relationships. Moreover, the control variables, namely 'age' and 'gender' were also entered into the equations.

Initially, the first factor component; namely, perceived usefulness was inserted as the outcome variable. All the other five factor components as well as the variables of "age" and "gender" were inserted as independent variables in the stepwise regression equation. The results indicated that there was a positive and significant relationship between perceived usefulness of the digital learning resources and the respondents' age where Spearman's rank correlation coefficient was 0.265 (Spearman's rho). This relationship was significant at (p <0.05). It transpired that the 'perceived usefulness' was dependent on the respondents' age (F = 10.457). Two regression equations were inconclusive when the factor components; namely, 'pace of technological innovation' and 'easy interaction' with DLRs were inserted as the dependent variables and all the other factor components were entered as independent variables (along with the 'age' and 'gender' variables).

Afterwards, the factor component; namely, 'technological anxiety' was inserted as the dependent variable and all the other five factor components were considered as possible antecendents (in the stepwise regression equation) the results indicated that there was a positive and significant relationship between 'technological anxiety' in using digital learning resources and 'age' where Spearman's rho was 0.217. This relationship was very significant at (p <0.01) and F = 6.872. Again, the stepwise regression indicated a positive and significant relationship between 'perceived ease of use of DLR' and the 'gender' variable. In this case, Spearman's rho was 0.191. This relationship was significant at (p <0.05) and the analysis of the variance; the F statistic was 5.274. When the factor component, 'effective use of DLR' was inserted as a dependent variable in the regression equation, the stepwise regression indicated that the 'age' variable was its antecedent. There was a positive and highly significant relationship (p > 0.001). Spearman's rho was 0.293. This equation shows that that an effective use of digital learning resources was dependent on the respondents' age (F = 13.084).

In conclusion, the stepwise regression analysis indicated that this study's hypotheses were all negative as there was no relationship between perceived usefulness and the perceived ease of use for mobile learning resources.

Moreover, there was no positive and significant relationship between perceived usefulness, perceived ease of use, the pace of technological innovativeness and technological anxiety. Nevertheless, this empirical study revealed that the acceptance of mobile learning resources in education was affected by gender and the age of respondents.

5. DISCUSSION, CONCLUSIONS & FUTURE RESEARCH

This empirical study has applied previously tried and tested measures from the 'pace of technological innovativeness'; 'technology acceptance' and 'technology anxiety' as it revealed the educators' attitudes and perceptions toward mobile learning resources. Moreover, it investigated whether socio-demographic variables affected the educators' perceived ease of use and the usefulness of mobile technologies in classroom activities. The quantitative results have indicated that there was a positive and highly significant relationship between the effective use of mobile resources and the respondents' age. In addition, there were significant relationships between the perceived usefulness of the digital learning resources and the respondents' age; between 'technological anxiety' in using digital learning resources and 'age' and between perceived ease of use and gender.

This study has shown that educators were aware that they ought to adapt their educational methodologies to today's realities. Evidently, they were already using digitally-mediated resources in their lessons. However, the educators also indicated that they were not extremely confident on how to use certain technologies in their lessons. The results suggest that teachers may require continuous professional development and training in this regard. The researcher believes that there is scope for educators to consider the results of this research, as ongoing investments in digital infrastructures will often result in improved engagement levels by teachers and students (Wastiau et al., 2013; Perrotta, 2013; Sampson, Isaias, Ifenthaler, & Spector, 2012; Sharples, Arnedillo-Sánchez, Milrad & Vavoula, 2009; Prensky, 2005).

Although the number of survey participants was sufficient in drawing conclusions about the educators' attitudes on the use of mobile learning resources in small EU country; this study is not amenable in drawing general conclusions in other contexts. The findings of this study ought to be supported by further research on mobile learning resources, including game-based learning and digital stories in other contexts. Perhaps, further research can specifically investigate the motivational appeal of mobile games in supporting educational outcomes. Moreover, there is scope in analysing the designs of electronic games and digital stories in terms of their complexities and sophistication levels. There may be diverse motivations in favour or against mobile learning among different demographics. In addition, the researcher believes that there is scope in undertaking face to face interviews with educational leaders including heads and assistant heads, as they may raise different concerns. There can be different digital literacies across other schools.

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