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Validating Mobile Devices in the Spanish University Entrance Exam English Paper

Abstract

The Spanish University Entrance Examination underwent significant changes in 2010 both in content and pedagogical validation. This paper examines the validation of cellular phones both for the test delivery and as students' valid personal devices for test preparation. 26 high school students (19 boys and two girls), aged between 16 and 18, who attended a middle class in a rural area of Valencia (Spain) took the Spanish University Entrance examination test through mobile phone emulators. This paper intends to outline the qualitative findings and some quantitative data from student surveys, the teacher's reactions and field observations. The results indicated that the majority of the students responded to close answer questions adequately and thought that this innovation was very motivating.

Key words: *m-learning, usability, multimodal interfaces, university entrance exams, on-line learning, wireless devices, Spain.*

Introduction

The rapid growth in information and communication technologies and new wireless devices has led to new forms of educational learning in the field of e-learning (Planella, 2004).

One of these new educational formats is based on interactive mobile communication (Freire, 2009). This mobility and the widespread use of mobile devices by students have created a new area of educational research into the concept known as m-learning. According to Mitchell (2003), m-learning is a valuable learning

method given the flexibility in time and space that permits students to learn at their own pace and according to their needs and will. Jihen Malek (2008) also backs this idea because m-learning takes place when the student is free to determine the place and time when learning actually happens by using appropriate technology. All these definitions lead to the idea that m-learning is extremely benefitial because it is the student's personality and interest that actually moves learning leaving behind the old idea of motivation and introducing a new concept of a capable learner who not only feels inclined to learn but is also capable of using the devices that permit him/her to do so (Sariola, 2001).

Researchers should combine these characteristics with what José Lozano Galera (2004) (President of the e-learning and on line training Association, AEFOL) calls the "e-learning triangle". The determining factors the researchers should take into account when using educational methodologies applied to the use of contents on mobile devices are:

1. The need to update processes and educational learning methods. Using universally available wireless technologies.
2. The development of learning, based on specific educational settings and contexts. Where the focus is on the acquisition of technological skills and the interactivity of existing telematic applications.
3. Adapting first order technological advances that promote digital communication skills to the specific needs of education. Serving as real effective support to activities that are carried out both in person and online.
4. Giving effective support to the adaption of national policies on the use of technology in education to promote a mobile society.

From the educational point of view, m-learning to support and complement the traditional e-learning can benefit students in the following modes (based on Kristiansen, 2001):

1. Mobile SMS listserves can be used to transfer and obtain new information more easily and quickly than by any other electronic means.
2. PDAs or e-books are light, and easier to carry than laptops and they carry as much information as text/workbooks, exercise books and pdf documents.
3. Digital handwriting recognition software on PDAs improves students' manual dexterity.
4. Notes can be made on the device during outdoor classes either by using the keyboard or by voice recording.
5. Using either the infrared function of a PDA or wireless technology such as Bluetooth facilitates team work as it makes it possible for students to share information with each other and the teacher.

6. The students' motivation and personal commitment to learning increases when using mobile devices and their use also increases their sense of responsibility.

Students in higher education are benefited by the use of mobile technology because they experience the following benefits (Seibu, 2008: 13):

1. *Ease of access.* Up-to-date knowledge is acquired on a permanent basis. Access to learning materials needs to be updated constantly without the space and time limitations imposed by traditional e-learning.
2. *Self-study options.* The flexibility of m-learning allows students to learn at their convenience.
3. *Assessment and feedback.* Immediate assessment tools can be incorporated into m-learning in order to check on students' progress.
4. *Online Access to study material.*

The study

Usability of the environment

The usability and functionality of educational material for mobile devices must focus on the process of creating content for the interactive technology used by these devices. Educational applications and tools must be specifically created or adapted for use on mobile devices rather than, as often happens at present, be badly designed or adapted from other devices without taking into account the specific requirements of the new environment (Author, 2009). In fact nowadays, commonly used communication applications, such as SMS and calendar alerts etc., have been easily adapted for higher educational purposes at a number of universities (Stone, 2004) and in some cases on face to face and online courses (Seppälä, 2003). Nevertheless, researchers find that the adaptation of the educational material used on these courses does not really take into account the interactive nature or the browsing methods available. Nor has the material been adjusted to adapt to the usability and functional needs of the environment.

When it comes to designing telematic applications, one of the main aims must be to obtain an intuitive interface, which is easy to use and learn. As far as mobile devices are concerned, this objective is primordial, and as such, their usability on these devices is key to their success on the market and with end users. As declared by Jacob Nielsen (2006: 17), "Usability is linked to ease of use. More specifically it refers to how quickly one can learn to use it, how efficient it is, how

memorable its functions are, how reliable it is and how much users enjoy using it. If a feature is not or cannot be used, it might as well not exist".

To guarantee the usability of mobile devices, it is absolutely vital that studies with real users are undertaken, where it can be demonstrated what impact an application that has been specifically created for educational purposes has on the new telematic environment.

Our work focuses on studying and discussing a pilot study with high school leavers to validate a tool for the adaptation and implementation of the Spanish language exam carried out on mobile devices, which forms part of the Spanish Education System's University Entrance Examination *Pruebas de Acceso a la Universidad* (PAU)[1]. In so doing, the researchers approached the impact of using the new technologies on the students' and teachers' attitudes towards using m-learning to develop strategies for the test (Author, 2006).

The design and development of the PAU language exam application has led to the production of a specific usability survey through which the researchers have been able to study any changes that students, during their part of the study at school, may have made to the application. This helps us to identify the most efficient functionalities of mobile applications and facilitates the creation of more intuitive environments. On the other hand, it must not be forgotten that the mobile devices have other limitations that affect their usability. These limitations must be borne in mind when designing both the application and the devices themselves (Author, 2009b).

Test design: delivery and m-tool

The researchers first performed the formal validation of the management tool and also the functional validation of the student's final telematic exam. The results obtained led to the verification and adaptation of management tool functions. The validation of the students' PAU exam was conducted by generating a functional prototype that emulates the end interface that is currently being developed and implemented. This type of emulator test is essential for calculating the degree of satisfaction with the end tool and for verifying the impact on the development of

[1] In general, to access university studies it is necessary to pass an entrance exam, which together with the grades obtained on completing secondary education make it possible to evaluate the academic maturity, knowledge and capacity of students to successfully follow a university course. The Government of Spain. The Ministry of Education. (2009) Education System. Access to University. (http://www.educacion.es/educacion/sistema-educativo/principios-fines/estructura/acceso-universidad.html) (16–08–09)

the telematic form of the students' exam. This point is significant, as it involves validating the limited navigation interface proposed by the research team (Figure 1).

Creation of the usability test was one of the tasks undertaken by all the research teams involved in the project. With formalization of the test and its methodological application to the secondary students, the researchers attempted to evaluate the impact of the online version of the test and to come to a conclusion about its use once the end tool was available. To achieve this, the following preparatory tasks were undertaken:

1. The entire contents of the official community of Valencia PAU exam for the year 2007 was adapted (Figure 1), adding a special section that included the oral test with the use of complementary audiovisual formats.
2. A 30 question user interface satisfaction survey, based on a Likert scale, was adapted (Lund, 2001) to calculate features linked to ease of use, how easy it was to learn to use the application, and level of satisfaction with the telematic development of the test
3. A group of students were chosen from a school in the Community of Valencia who were going to take the University entrance language exam for that year.

Figure 1: Adaptation of the different types of question: Multiple selections using a drop-down menu. Multiple selections used for extended answers (Authors, in press)

Developing the usability test with secondary school students

The institute granted permission to conduct the tests in a computer classroom in the centre with all the necessary resources, where the prototype for the test was installed. The students' permission was also obtained to take photographs of them

and use the data of their results for our research. When designing the usability test, the researchers decided that, if possible, the test should be carried out in the users' own environment, where they can be observed using their own equipment in their usual surroundings, thus affording a more realistic view of the experience. It is also important for the profile of the test participants to be as close as possible to that of the potential users. With these requirements in mind, the researchers conducted the test in a secondary school in a rural area near Valencia (Spain). 26 high school leavers (between 18 and 21 years of age) took the test. (Figure 2)

Figure 2: Conducting the usability and functionality test of the digital PAU exam at the secondary school in Teulada, Valencia, Spain, 2009

Then, the researchers followed these steps: Firstly, the students were asked to complete a questionnaire on mobile use, in which important information was obtained on mobile management and environment and the general characteristics of the mobiles the students use.

Secondly, a simulation language test using a mobile emulator was carried out. And finally, a test was given based on short questions about the learning experience shown in the simulation. This last test was performed by 20 students from the group.

To evaluate the usability of the interface, a 30 question user interface satisfaction survey was used (Pelman, 1997). The survey attempts to measure how useful the tool is, how easy it is to use, how easy it is to learn to use the tool and the degree of satisfaction with it. A Likert scale of 0 to 5 was used (Ávila, 2006).

The mobile device simulation was performed using a mobile telephone emulator, the characteristics of which were: screen size 240x320 px, 18 bit colour depth, pixel rate RGB 16 16.565, Nokia OS operating system, a Series 40 3rd edition platform, Feature pack 2. The available memory was: 1920Kb of dynamic memory; 256 Kb of persistent storage; 4 kb of video storage. As no external input system was available the mobile phone's own keyboard was used to input data. The phone was equipped with a 4 way navigation system and a set of SoftKeys. The device reproduced images in the following formats BMP, GIF, JPEG and PNG; video formats 3GPP, 3GPP2, MP4 with cropping capability to adjust height, reduce the image to fit the screen size and maintain the ratio. As for sound, the device was equipped with an x-MIDI, stereo audio channel with a sampling rate of 44 KHz and a maximum volume of 100. The default browser was the Nokia Mini Map Browser, which recognizes the following formats: HTML 4.0, HTML 4.01, WML 2.0, XHTML 1.0, Flash Lite 2.0.

Data analysis

Of the two questionnaires used, the first, as mentioned earlier, evaluated general data on mobile use. (cf. Chart 1)[2]. In relation to their satisfaction about doing the Spanish University Entrance exams (PAU) through a mobile phone (using the emulator), 26 students completed the test. As mentioned previously, the survey evaluated a variety of aspects. Learning time, time taken to complete the tasks, percentage of user errors, retention over time, subjective satisfaction, are all the aspects that allow us to make a practical evaluation.

In Table 1 the researchers can see that all the variables correlate positively, except "it saves my time", which does not correlate with any other variable in its group. In Table 2 the researchers can see that there is a complete correlation between the variables in the group.

[2] Interpreting the data: the variables that correlate at the level of 0.01 (99%) are coloured dark green and the variables that correlate at the level of 0.05 (99%) are coloured light green.

Table 1: Correlations between the variables in the group "Utility"[2]

	The design helps me to be more efficient	The design helps me to be more productive	It is useful	I have more control of the compo-nents	It makes it easy to do things	It saves my time	It answers my needs	It fulfils my expectations
The design helps me to be more efficient	1	.953(**)	.752(**)	.710(**)	.660(**)	.216	.585(**)	.600(**)
The design helps me to be more productive	.953(**)	1	.756(**)	.636(**)	.682(**)	.280	.622(**)	.661(**)
It is useful	.752(**)	.756(**)	1	.741(**)	.867(**)	.523(*)	.868(**)	.853(**)
I have more control of the components	.710(**)	.636(**)	.741(**)	1	.722(**)	.537(*)	.610(**)	.612(**)
It makes it easy to do things	.660(**)	.682(**)	.867(**)	.722(**)	1	.718(**)	.919(**)	.892(**)
It saves my time	.216	.280	.523(*)	.537(*)	.718(**)	1	.763(**)	.732(**)
It answers my needs	.585(**)	.622(**)	.868(**)	.610(**)	.919(**)	.763(**)	1	.952(**)
It fulfils my expecta-tions	.600(**)	.661(**)	.853(**)	.612(**)	.892(**)	.732(**)	.952(**)	1

Qualitative analysis and contributions to pedagogy

According to these results, the researchers collected data in two ways: Direct observation and the questionnaire. The results of the questionnaire have been discussed briefly above but the researchers would like to summarize them and also add the researchers ' observations:

1. Students are motivated by the use of mobiles for the test. They also find no significant differences between the construct for the mobile based test as opposed to an Internet based test and a pen-and-paper test.
2. The interfaces were user-friendly enough so students did not have to use either human or online support tutorials.
3. The design made the test accessible to the students.
4. Students were very interactive and engaged with the testing system in multiple choice sections but found it difficult to work with writing and reading. In relation to speaking and listening the researchers observed that students proved to be more capable with these oral tasks.
5. The system could be used for the most difficult delivery tasks of online testing: speaking and listening.

This research sheds light on a very untouched aspect of education which is the m-learning technology for language testing. The findings indicate that apart from being very motivating for the students, m-learning technology would be valuable to develop testing strategies and deliver online oral (speaking)and listening tests. In fact, this experiment shows that more m-technology could be used to facilitate the delivery of online tests. Apart from that, this technology could be used by publishers and testing boards to incorporate sample tests for prospective candidates in high stakes testing. The results also support the need to extend current research into adaptive learning environments as well as to find whether new ergonomic and cognitive styles can be emphasized or developed beyond the traditional online learning and testing.

Conclusions

In recent years the expansion of mobile devices and the indiscriminate use of their contents have given rise to the need to adapt them to the new circumstances. There are few published studies about adapting the contents of these m-devices. For this reason, the researchers decided to evaluate the experience of adapting the contents for a group of students sitting a mobile based language exam. The questionnaires addressed fist the use of mobiles for further implementation and

the second part of the survey dealt with satisfaction with the mobile application and evaluated a variety of concepts, such as learning time, time taken to complete tasks, percentage of errors made by the user, retention over time, subjective satisfaction. The best case scenario would be for all the categories to be successful, but as often happens in development certain processes have been sacrificed. If it is possible to extend learning time then, by using abbreviations and shortcuts that are complicated to use, the time taken to carry out tasks can be reduced. If the percentage of errors is kept really low it is probable that the speed with which tasks are executed is sacrificed. At other times it could be that subjective satisfaction, or a relatively short learning time, or that the rapid executions of tasks is the goal. To be successful in all these areas would be the most desirable outcome and all these requirements were taken into account at the start of the project. They are included in the project guidelines. Our intention was for the students to find it useful, for it to be effective, productive, to make things easy, to respond to the students' expectations and to do the things it was designed to do efficiently. If the tables are to be believed, it would appear that the students found it to be just so. Learnability was another of our principal interests, as the application will be used by a large number of students who are more or less familiar with mobile technology and will have to learn to use the application in a short space of time. The students also positively evaluated the application's learnability.

The researchers should also point out the significant number of correlations between the "utility" and "satisfaction" groups. Practically all the variables correlate positively.

From this the researchers can infer that the students are extremely satisfied with the application and consider it to be highly useful. This shows that, although there are still certain features of the application that need revising, in general our expectations have been met. Since many students acknowledged that the m-system does not facilitate the timing for the test, certain concepts require further analysis and a more in-depth revision in order to improve the application. This initial trial shows that the researchers are on the right track; our approach of adapting content to the new environment is effective, giving a vote of confidence to the use of mobile devices in Spanish university entrance language exams and to the impact this could have on future advances in learning methodology and validation in the field of m-learning.

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Bibliography

Ávila H.L. (2006). "Introducción a la metodología de la investigación." Capitulo 3.6 Construcción de Índices y Escalas; 82–84

Freire, S.(2009). "M-learning: aprendizaje electrónico móvil." *Sociedad de la Información Estudios de Información y Comunicación, Documentación,* Universitat Oberta de Catalunya (http://ictconsequences.net/uoc/sociedadinformacion/2009/04/28/m-learning-aprendizaje-electronico-movil/) (28-02-2009)

Kristiansen, T. (2001). "M-learning. Experiences From The Use of WAP as a Supplement in learning." Oslo, Fornebu Knowation. In Szucs, A., Wagner, E. & Holmberg, C. (eds.), *Learning Without Limits. Developing the Next Generation of Education*. Proceedings of the EDEN 10th Anniversary Conference, Stockholm; 10–13.

Lozano, J. (2004). "El triángulo del e-learning." *Reflexiones o artículos acerca del e-learning* (http://www.telepolis.com/cgi-bin/web/DISTRITODOCVIEW?url=/1589/doc/Reflexiones/triangulo.htm) (16–08–09)

Lund, AM (2001). "Measuring Usability with the USE Questionnaire." *STC Usability SIG Newsletter*, *8(2)*, (http://www.stcsig.org/usability/newsletter/0110_measuring_with_use.html)(12–08–09).

Malek, J. ; Laroussi, M. & otros (2008). A Context-Aware Approach for Modeling Bijective Adaptations Between Context and Activity in a Mobile and Collaborative Learning. *International Journal of Interactive Mobile Technologies (iJIM), 2*; 20

Mitchell, J. (2003). "E-business and Online Learning: Connections and opportunities for VET." *Australian National Training Authority*

Najime, D. & Rachida, A. (2008). An Adaptation of E-learning Standards to M-learning. *International Journal of Interactive Mobile Technologies (iJIM) 2*; 11.

Nielsen J., (2006). "Prioritizing Web Usability." *Ediciones Anaya multimedia*; 17

Pelman. G.(1997). "Practical Usability Evaluation." *CHI 97 Electronic Publications: Tutorials.* (http://sigchi.org/chi97/proceedings/tutorial/gp.htm)(11–08–09)

Planella, J. & Rodríguez, I. (2004). "E-learning e innovación social: La necesidad de un debate interdisciplinar." *Revista de Universidad y Sociedad del Conocimiento* (RUSC) UOC, Vol 1; 02–03 (http://www.uoc.edu/rusc/dt/esp/rusc1_monografico.pdf) (05–08–09)

Sariola, J. ; Sampson, J & otros.(2001). Promoting MLearning by the UniWap project within higher education. *International Conference on Technology and Education*. Florida State University. Tallahassee,

Seibu M.J. & Biju I. (2008). Mobile Technologies and its impact – an analysis in higher education context. *International Journal of Interactive Mobile Technologies (iJIM) 2*; 13.

Seppälä, P. &. Alamäki, H. (2003). Mobile learning in teacher training. *Journal of Computer Assisted Learning, 19*; 330–335

Stone, A. (2004). Mobile Scaffolding: An Experiment in Using SMS Text Messaging to Support First Year University Students. *Advanced Learning Technologies. Proceedings. IEEE International Conference on;* 405–409.