What is mLearning and How Can It Be Used to Support Learning and Teaching in Econometrics?

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Abstract: The aim of case this study was to analyze the integration of mobile learning technologies in a postgraduate course in Finance (MSc in Finance) at Dublin Institute of Technology, where econometrics is an important course component. Previous experience with students undertaking econometrics modules supported this analysis, where the researcher detected a clear need for learning support. Econometrics courses are heavily supported by the use of sophisticated statistical software, the availability of which is normally restricted to designated labs in the college. As a result, this project has developed an application that facilitates students' access to econometrics course work, where a mobile device was used. The main objective of the project was to enable students to bring their course material home with them and use it anywhere, at any time, so that the basic material covered in class could be consulted and reviewed as many times as the students need. The results of this project are very encouraging, as evidence suggests mobile technologies can play a positive role in improving students' learning experience. Teachers should consider using mobile technologies to support their work in the classroom. In this context, smart phones and PC tablets, the devices used during this study, have proved to be particularly effective.

Keywords: eLearning, mLearning, iPad, iPhone, website, action learning, econometrics

Introduction

In Friedman's (2005) vision of a globalised future, the two main drivers of change include economic competition and technological advances. In this context, science, engineering, and technology education are arguably the key to success. Accordingly, the education system needs to be adjusted by integrating new technologies into its structure, programmers, and instructor training. The aim of this study is to explore the positive and negative effects of new technology in higher education. It specifically focuses on analyzing the concept and practice of mobile learning (mLearning) in higher education, and exploring how blended learning could be used to enhance students' progress. In this respect, it is important to consider where technology might take the academic community, whether we want to go there, and whether we have a choice.

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In the last few decades, numerous studies illustrated the various ways our technologically informed society has affected the system of education. Previous research showed that new technologies are conceived to be the panacea to minimizing education costs and maximizing students' learning experiences (Naismith, Lonsdale, Vavoula, Sharples, 2004). Nevertheless, other studies showed that there are important limitations associated with the use of technology when supporting learners (Kukulska-Hulme, 2009; Lowendahl & Harris, 2009), and that barriers must still be overcome in order to achieve success in this domain. As a result, the main focus of this project is to examine whether blended learning can help integrate the use of technology (with a special emphasis on mobile learning technologies) into students' learning experiences.

Project Context and Rationale

This section provides a general evaluation of pedagogical and andragogical teaching, as well as learning models and their importance in higher education. As it is a common trend among teaching professionals to confuse these methodologies, it is not infrequent that inappropriate teaching methods are used in higher education (Pew, 2007). A major problem "arises when pedagogical methods and practices are applied (in whole or in part) to situations that require" *andragogical dynamics*" [emphasis added] (Pew, 2007, p. 14). It is therefore necessary that higher education institutions analyze and assess the needs of potential students and adjust their teaching methodologies accordingly. Neglecting to do so will contribute to the risk of offering a product that does not satisfy students' or employers' demands.

Universities and colleges need to adjust their teaching systems in order to provide products tailored to individual student needs. In this respect, the role of the teacher needs to be very clear and this is where the major challenge lies. Being an instructor accustomed to interacting in a face to face environment, it is the current researcher's responsibility to motivate and encourage the student's learning process (pedagogical approach). Moreover, from an andragogical point of view (Pew, 2007), the motivation and desire to learn is implicit in every student, particularly in those undertaking postgraduate courses. The teacher's role should therefore focus on facilitating and enriching the learning process. In this context, mobile learning technologies are deemed to play a central role in higher education. The use of mobile learning and the integration of appropriate technologies allow students to move the learning process out of the classroom and use their time more efficiently; it is the teachers' role to motivate their students and, more importantly, to create a need for learning. In this respect, the fundamental responsibility of a higher education teacher is to create a learning environment that motivates and encourages the students' learning process both inside and outside of the classroom. In this way, students will be able to gain knowledge and develop critical thinking skills in their chosen area of study. As a result, the ultimate goal should be centered on arming students with the ability to analyze problems and provide optimal solutions to real issues in their field (Marquardt, 1998).

The Aim of this Study and Research Questions

The use of electronic and mobile technologies might better engage higher education students and even change the passive attitude towards learning that teachers' occasionally find (Naismith et al., 2004). Nowadays, many people, especially young people, are familiar and skilled

with mobile phone technology (Chan & Ford, 2007). These skills can be used to attract the more reluctant young learners and help improve their aptitude for learning. If we take into consideration that the majority of students bring their own computing/mobile devices (e.g. pocket PCs, smart phones, notebooks, tablet PCs, graphical calculators, electronic dictionaries, etc.) into the classroom (Goh, & Kinshuk, 2006), a simple question arises: "why not use those devices as a learning tool?" Such devices enable students to access eLearning content anytime and anywhere, both inside and outside of the university/college setting. This educational mobility has been referred to as ubiquitous learning or uLearning (Granić, Ćukušić, & Walker, 2009). The literature has reported that students take great pride in their work when ICT (Information and Communication Technologies) is used for learning, and has indicated that ICT motivates students in their school work (Brown, 2005; Sime & Prestley, 2005). Therefore, the implementation of ICT within the learning process can lead to positive motivational outcomes, independent work, and enhanced creativity (Brown, 2005). In this context, the present study examined mLearning technologies and their potential in higher education. More specifically, the researcher examined how a mobile device (iPhone, iPod touch and/or iPad) can transform students' learning experiences. Hence, the main research questions addressed how teaching and learning models are supported by technology. The questions presented below focus on how mobile devices can be used to facilitate the learning process of postgraduate finance students undertaking a module in econometrics.

Main Research Questions

1. What is the role of mLearning in delivering econometrics courses to postgraduate finance students?
2. How does the iPad or iPhone represent an initial movement towards the integration of mLearning in postgraduate finance courses?
   2.1 How can the iPad or iPhone be used to enhance student learning in an MSc. In Finance with econometrics?

The MSc in Finance at DIT is a course designed to target individuals with a strong interest in finance. In addition, potential students should demonstrate previous knowledge of finance and a basic understanding of econometrics principles. Overall, the student should have a business background and should be comfortable using technologies and standard office software. However, it is not expected that students posses advanced knowledge of specialized software like Eviews, Stata, or Rats. The course is designed to start from the basics and to progress to a more advanced level according to the course syllabus and student demand during the academic year. The students in this group were ideal candidates for this project due to the advanced level econometrics they studied. It was deemed necessary to develop and introduce support material that would help students to access their course material according to their individual needs as it was identified that teach student required different support to be able to understand the basics of the subject. Moreover, the expectation was that the answers to the above research questions would help increase our understanding and knowledge of how mobile technologies can be used to support postgraduate finance students' lifelong-learning experience, and how their learning can be integrated in their daily routines.

The Importance of mLearning

A review of the literature in mobile learning reveals that mLearning theories are lacking (Goh & Kinshuk, 2006; Muyinda, 2007; Naismith et al. 2004). There also appears to be little understanding of how mobile technologies relate to both traditional and innovative ways of teaching and learning. Overall, existing studies (McConatha, Praul, & Lynch, 2008, Sharples, 2000 and Muyinda, 2007) seem to agree that mobile learning is a form of eLearning that specifically employs wireless communication devices to deliver learning content and support student learning outside the traditional environment. As a result, "mobile learning has emerged as an educational application from advances in mobile computing and handheld devices (i.e. phones, smart phones, PDAs, [pocket PCs] or laptops), intelligent user interfaces, context modelling, wireless communications and networking technologies (Wi-Fi, Blue Tooth, GPS, GSM, GPRS, 3G)" (Muyinda, 2007). Nevertheless, a clear distinction between classroom and mobile learning needs to be established.

Mobile devices support the delivery of both synchronous and asynchronous learning. In informal settings mobile devices support both intentional and unintentional learning (Kelly, 2002 & Wagner, 2008b). Thus, mLearning can function as a supplement to formal teaching and learning. In this regard, advocates of mLearning recognize the fact that it cannot be used completely alone and should ideally be blended with other methods of delivery, such as face-to-face, print, and online learning. In this context, a blended learning approach is more appropriate than an individual one. The main challenge for educators using mLearning technologies rests in their ability to find ways to guarantee that students' learning will be highly situated, personal, collaborative, and long term. Teachers must clearly understand what pedagogical and andragogical teaching models are and how they should be integrated in the learning environment. This comprises a learner-centered approach that will move more and more outside of the classroom and into the learners' environment. In other words, virtual and mLearning approaches need to be considered as key models that will provide the type of education that meets students' demands more efficiently and where a mixture of teaching models should be used.

Literature Review

The literature analyzing mLearning is recent but fast growing, with the first studies published at the turn of this century (McConatha, Praul, & Lynch, 2008). Sharples (2000), who examined the potential of mobile technologies and their role in education, was one of the first authors publishing in this area. Sharples analysed how mobile technologies can be integrated into adult education programmers with the aim of enhancing and promoting lifelong learning. According to Peng, Su, Chou, and Tsai (2009), it is only "in the last four years that explorative studies have set out to investigate pedagogies for mobile learning". In this line of research, an early study by Hardless et al. (2000; as cited in Peng et al., 2009) "employed social constructivism and cognitive apprenticeship to support their ideas on collaborative learning and education for mobile people". In addition, Hill et al. (2000; as cited in Peng et at., 2009) "utilize constructivism as a pedagogical model for their ubiquitous computing theory. Furthermore, Sharples (2000, as cited in Peng et at., 2009) "grounded on the idea that the human learning is highly situated" […], suggested that the convergence of personal technology and lifelong learning (LLL) may

"empower people to manage their own learning in a variety of contexts throughout their lifetimes". For Peng et at. (2009) further investigation of the constructivism and LLL theories may provide educators with important information about curricula development in relation to mobile learning."

According to Beale (2006) and Sharpes (2006) (as cited in Looi et al., 2010, p.155) "previous mobile learning research … has typically focused on either formal or informal settings and failed to examine the integrated and synergetic effects of linking these two contexts or environments of learning". Given the ubiquitous nature of mobile technology, "the portability and versatility of mobile devices has significant potential in promoting a pedagogical shift from didactic teacher-centered to participatory student-centered learning. In this type of learning culture, teachers act as facilitators and learning partners rather than … experts" (Looi et al., 2010, p. 156). In conclusion, mobile learning is quite recent but its role in education is growing fast and many changes are expected to occur in the future of higher education.

Mobile Learning Main Challenges

This section examines the challenges faced in mobile learning in higher education institutions. In our current era, learning has evolved into a dynamic practice that takes place during the whole life of the individual. As a result, higher education institutions "must recognise that adults have blended lifestyles with multiple roles" (Kelly, 2002). Third level education has changed and is no longer only consumed by young adults with the sole responsibility of concentrating on their studies. More and more, the classroom is composed of a mixture of both young and mature students with a broad range of personal responsibilities, seeking to use their time efficiently with clear learning objectives. Consequently, higher education institutions have to manage classrooms composed of young adults starting third level education, and adults that are returning to the classroom. The latter "have to combine learning with work, family, and leisure activities" (Kelly, 2002). However, "many universities unintentionally create barriers that prevent mature students from participating in higher education as a form of lifelong learning" (Kelly, 2002). Higher education institutions "must become more learner focused [by] using [an appropriate learning paradigm] to encourage and facilitate lifelong learning" (Kelly, 2002). In this context, it is important to enable individuals to learn in a way that makes best use of their time and abilities. The role of mobile learning is deemed fundamental in this respect, as individuals will be able to use devices that contain all the information they need, and access their learning material anywhere, at any time (ubiquitous learning).

The current status of mobile learning is leaning towards enterprise mobility, "a state of technological readiness where users have full access to resources regardless of their physical location" (Wagner, 2008b). As such, "one of the self-evident uses for mobile devices, networks, and services is providing support for learning and performance at the point of demand or need" (Wagner, 2008b).

The eLearning Guild defines mobile learning (mLearning) as follows:

any activity that allows individuals to be more productive when consuming, interacting with or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity and fits in a pocket or purse (Wexler, Brown, Metcalf, Rogers, & Wagner, 2008, p. 7).

Following the above definition, it is evident that mobile phones are a perfect fit for it. However, the whole research process raises some questions with regard to the iPad, as features on this device do not fulfill the requirement of fitting in a pocket or purse. On the other hand, the iPad is easy to transport in a handbag or shoulder bag which gives the characteristic of *mobile* to the device. Hence, Wexler et al.'s definition of mobile learning needs to be more flexible for the purpose of this study.

Mobile learning can be understood as a way of improving productivity, as it allows an individual to use inactive time in a more productive way. The key determinants of mLearning success, as perceived by users, are based on the convergence of mobile devices with existing educational technologies (Wang & Shen, 2008). This provides learners with greater flexibility by making learning material available and accessible anywhere and at any time. Moreover, the use of ICT facilitates knowledge sharing and cooperative learning among knowledge management activities.

An analysis of the pedagogical paradigm shows that "teachers assume responsibility for what is learned, and how and when something [should] be learned" (Pew, 2007). Thus, the pedagogical model is a teacher-directed or teacher-centred approach to learning (Pew, 2007). However, the andragogical paradigm is considered as a learning approach where the teacher facilitates adult learning. Along these lines, Conner (2004) identified five statements related to the andragogical model:

1) Letting learners know why something is important to learn, 2) showing learners how to direct themselves through information, 3) relating the topic to the learner's experiences, 4) people will not learn until they are ready and motivated to learn, [and finally], 5) [the learning experience entails helping students] overcome inhibitions, behaviors, and beliefs about learning (Conner, 1997-2004, p. 12, as cited in Pew, 2007, p.17).

Consequently, there are important differences between these two educational paradigms; in the pedagogical approach the teacher transmits knowledge and controls the process at every stage; in the andragogical approach the teacher facilitates learning and supports students when needed, where a great effort is dedicated to incentivizing critical analysis and thinking, and where the learner is responsible for his/her learning outcomes.

The main challenge for teachers using any educational model is to have a clear understanding of the paradigm being implemented; in this way, teachers can adjust their techniques to the environment without the risk of failure. In the case of mobile learning, students are responsible for their own learning and the role of the instructor is to facilitate the learning process, not to motivate or worry about the students' commitment to their own learning. As a result, the core responsibility of instructors using education technology with students that

increasingly use mobile technology is to find a way to integrate their classes into the dynamics of mLearning; along these lines students will be able to maximize their learning experience.

Bullen (1995) raised questions about the importance of andragogy and concludes that andragogy is only relevant in certain situations when it is clearly needed. According to Knowles (1980) the key characteristics of adult students can be identified as: i) self- directed individuals, ii) have a task or problem-centered orientation to learning, iii) are internally motivated, iv) have life experiences, which are a rich resource for learning, and v) a readiness to learn. However, research analyzing the appropriateness of the andragogical approach concluded that assumptions should not be made in relation to adult learners, as each individual is different and has a different level of confidence as a learner (Burge, 1988). Thus, what learners report about their learning preferences may not always manifest when they engage in their studies. Consequently, in some cases it may be necessary to adopt a pedagogical approach that helps students at the beginning of their studies, and subsequently progress into an andragogical approach. In order to succeed, mobile-learning education needs to be flexible and readily adjusted to students' needs. It is not possible to identify one individual model that will fit all types of learners' needs, particularly in situations where students are interacting in an environment where they have direct contact with their instructors and can decide what and how they want to learn. In this context it is necessary for instructors to adopt an andragogical-pedagogical approach, which can be used in a manner that suits the type of students they work with. It is well known that every class is different, and techniques that are appropriate with one group may not be successful with another, meaning that the teacher needs to be able to change his/her class dynamics if problems are detected.

According to Wagner (2008a), certain key developments over the past few decades have vastly improved interactive mobile devices, where the following changes can be highlighted:

1. The convergence of telephony, computer and broadcasting functions, due to the shift from analog to digital sign systems.
2. The emergence of browsers, the World Wide Web, and now the "mobile" web.
3. The broad availability of development tools that create multimedia content (SWF), video content (FLV), and document content (PDF).
4. Better device processing power, functionality and displays.
5. More powerful networks and services, including cellular, Wi-Fi, and WIMAX technologies.

Research on mobile learning suggested that the success of mobile learners depends on how strong the focus is on enterprise mobility (Wagner, 2008a). It also depends "on eventually finding common ground among trainee designers, enterprise IT managers, […] business stakeholders, and enterprise end users" (Wagner, 2008a). However, the main challenge to be able to integrate mobile technologies in the classroom lies in the ability of teachers to take up the challenge. Additionally, prudence must be in place as the management and implementation of this learning device implies that students can get distracted by gadgets rather than use them to support their learning (Banister, 2010). Therefore, teachers need to find the right approach incorporating

new technologies into the classroom, taking care not to place too much emphasis on the actual technology rather than on the course content.

The Role of Mobile Technologies in Education

In contrast to traditional classroom practice, the use of mobile technologies offers many benefits to students and teachers. This is due to features such as ubiquitous learning as well as "wearable" computing and multimedia content delivery via mobile devices that allow the learner to be "connected" wherever and whenever they choose. As a result, learners are able to continue their studies outside the classroom in a way that satisfies their individual needs. The "just enough, just in time, just for me" model of flexible learning will be the key to supporting students' demands (Peters, 2007).

The use and evolution of mobile technologies have exposed the need for re- structuring traditional learning programs. The educational sector needs to move according to times with the aim of introducing "strategies, applications, and [the necessary] resources to support anywhere-anytime connections to formal and situational learning, as well as personal interest explorations" (Wagner, 2005; as cited in Shih & Mills, 2007). This is because "the academic environment has been introduced to mobile learning through the use of laptops, PDAs, and smart phones" (Shih & Mills, 2007, p.2). As a result, mobile technologies are taking solid steps in the development of technology-mediated teaching and learning (Shih & Mills, 2007). This type of technology allows people to be connected and "offers the opportunity for a spontaneous, personal informal and situated learning [to take place]" (Shih & Mills, 2007). In this case, the new paradigm of education is based on the idea of flexible learning (see Figure 1), where education is served as "just enough, just in time and just for me" (Peters, 2007).
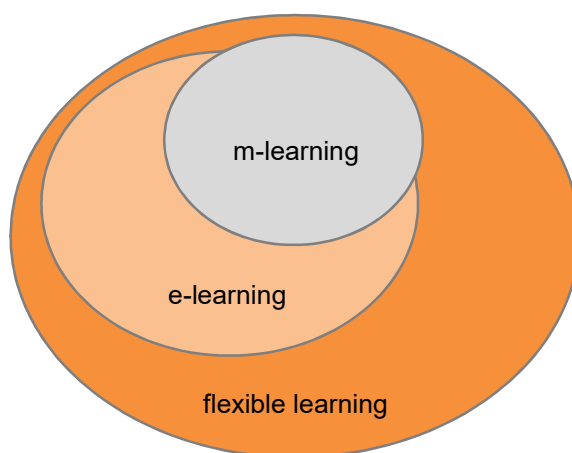

Figure 1. The "just enough, just in time, just for me" model of flexible learning (Peters, 2007).

As a result, the learning and teaching model that has been used in higher education in the past is becoming obsolete, and if institutions are to cope with a dynamic and challenging educational environment they need to be ready to adjust and evolve. It is evident that mobile

technologies are here to stay and failing to integrate them in the classroom might end up with an institution that will not equip its students with the skills that are demanded by employers and this will be translated in future professionals that will not be able to compete in a globalised and fast moving economy.

Benefits of Mobile Learning

Mobile learning acts as a main support to extend and improve learners' "capacity[ies] to communicate and access information by allowing them to carry 'wireless, mobile, portable, and handheld devices'" (Traxler, 2008; as cited in Koole, McQuilkin, & Ally, 2010). Moreover, Roschelle (2003) asserted that "mobile technologies in education will succeed to the extent that … [there is] mutual engagement of a teacher and students in social practices of learning … emphasizing learner-centered, assessment-centered, knowledge-centered and community-centered practices" (p. 271). Given that "mobile learning allows … students maintain connections and commitments to learning activities in ways that previously were largely impossible, it also benefits the communities in which these people are not students, but rather skilled and dedicated professionals" (Beckmann, 2010). Furthermore, learning with mobile technology has clearly shown that "the mobility and connectivity of technological tools enable students to become an active participant [rather than] a passive receiver of [information]" (Looi et al., 2010).

According to Beckmann (2010):

"Educators can integrate technologies into their courses in a way that facilitates learning for all students, whether they are on- or off campus, static or mobile. However, although mobile technologies offer a new field to explore in distributing and sharing learning opportunities, and educators must continue to fine-tune their use of such technologies, the spotlight must remain firmly on pedagogical content rather than on the technology being used to deliver that content. (p. 171)."

The benefits of mobile learning and the use of mobile technologies to support students' demands is well recognized by education and training providers (Peters, 2007). Nevertheless, there are still important limitations with regard to the implementation of this type of technology in the classroom (Peters, 2007). A study developed by Peters (2007) pointed out that one of the major constraints is associated with the age and ability of the teacher to integrate these technologies in their teaching routines. Moreover, the slow rate of change in large educational institutions is another factor to consider, as mobile devices are not designed with the education market in mind (Peters, 2007).

From this perspective, it is important to consider the implications for teachers and students dealing with econometrics material and software. Firstly, teachers need to make sure that they do not cause distraction in the classroom through the introduction of new technologies like the iPad/iPhone. The material that students need to cover and become familiar with is quite complex and dealing with specialized software at the same time can be a daunting task. Students need to master the theoretical aspect of the course and at the same time deal with its practical side, with the application of models and theory through econometrics software. Introducing devices that require the use of even more software, like iTunes, video formats, podcasts, etc., might simply add more difficulty to the course for individuals that are not technological savvy.

Consequently, the teacher needs to find an appropriate balance that adds real value to classes rather than adding difficulty to the learning process itself.

Existing Research Conclusions

Research which explored the benefits and challenges of mobile learning in higher education suggested that teachers need to adjust in order to encourage change. Teachers need to be aware that student-learning demands have evolved and as a result they need to provide more than just a lecture series to satisfy students' needs and requirements (Stay et al., 2010). Mobile technologies are the key to helping them to achieve their goal. According to Stav, Nielsen, Hansen-Nygård, & Thorseth (2010), teachers need to provide a learning environment that stimulates enjoyable and engaging lectures. A recent report from the MacArthur Foundation has pointed out "that social-network sites, online games, video-sharing sites and gadgets such as iPods and mobile phones are now fixtures of youth culture" (Hansen, 2008; as cited in Stav et al., 2010, p. 182). Therefore, the question is: can the education system succeed without integrating these new technologies into learning programs? Considering the emerging potential of mobile technologies with a thriving growth of consumers adopting new technologies, it appears that mLearning is taking its own place in mainstream education and training. As a result, higher education institutions, and especially teachers, need to be ready to adjust to new technology. More importantly, they need to be able to integrate these new technologies into the classroom in order to satisfy students' needs.

Research Epistemology and Theoretical Perspective

The econometrics discipline is characterized by its complexity (mainly based on disciplines like mathematics, economics and statistics) and is concerned with data analysis; with the aim of implementing models that can help the researcher/analyst understand economic and financial reality. This field of research seeks to elaborate sophisticated models that can help economists and financial analysts develop sound investment strategies, economic policies, etc. Therefore, the epistemological framework used in this field is clearly in line with the positivist paradigm, which is based on the use of scientific methods for investigating an aspect of reality (Wicks & Freeman, 1998). Alternatively, social constructionism is a theoretical orientation that "assumes that reality is constructed via a dynamic, cultural, historical and political process" (Marshall, Kelder, & Perry, 2005). According to Marshall et al. (2005), "[i]t also accepts that [analysts] construct their own pictures of reality so that multiple subjective realities are possible in every … situation … [via] communication and negotiation between [individuals]". For these authors, "[s]uch assumptions about reality lead to research designs … that encourage richer, deeper and more realistic insights into research practices" (2005). Social constructionism has a social rather than an individual focus; it looks at how individuals construct their reality and how groups of individuals communicate and negotiate their individual perceptions of reality (Young & Collin, 2004). Following an analysis of the core concepts sustaining the positivist and social constructionist paradigms, a postgraduate program where econometrics is a major component should take into account both paradigms. Considering the current economic climate, future professionals in the field of economics and finance need to be equipped with advanced analytical skills, as their

jobs will require them to gather and analyze data, design appropriate models, and interpret the results obtained in order to disseminate their findings to a wide audience.

In view of the factors outlined above, the developed study has been heavily influenced by positivist and social constructionist paradigms.

Methods and Methodology

This study took place during the 2010/11 academic year, with the main objective of gathering enough information to facilitate the creation of an efficient application (website and app) that could be used by students with an iPad or iPhone, smart phone or appropriate mobile devices to support students' learning. The study was carried out with a group of 22 students undertaking an MSc in Finance at DIT. The researcher chose to use the iPad device, as it would provide a good opportunity to assess the features of this tool as well as the feasibility of its use in economics and finance programs. However, the affordability and availability of the iPad for students was considered as an important limitation to this learning strategy, especially during the current economic climate where many families are suffering monetary constraints. This should be considered in the years to come, as the current economic situation will probably put major restrictions on individuals for the foreseeable future. Being aware of this issue, and in consideration of those who do not have an iPad, the iPhone was also used to assess the effectiveness of the designed application.

This study was carried out in three main phases: a) During the first semester (September 2010 to February 2011) the website and the app for the iPad/iPhone were designed with the aim of creating a resource that would support and facilitate student learning experiences in their "Econometrics 2 with Time Series Analysis" module. The main task consisted of adjusting the module's material to the device, and making sure that everything needed to complete the course successfully was available in the website and app. b) The students undertaking the Econometrics module during the second semester of the academic year 2010/11 (February 2011 to May 2011) were exposed to the learning website and app, where three sessions were offered to allow students use and understand them and interact with them on their iPad/iPhone. It is important to bear in mind that not every student had access to an iPad/iPhone, so the researcher gave them a loan of an iPad during this seven-day period, so every student was able to test the website and the app. c) Finally, the evaluation of the website and app took place. The study was supported with two main surveys where a selection of ten students (from the MSc in Finance) and five lecturers (specialized in Economics and Finance) were chosen to assess the learning website and the app. The first assessment consisted of a general survey, where ten students undertaking the module were asked to fill out a questionnaire. The questionnaire was designed to: 1) assess the website and the app, 2) find out whether or not students perceived any kind of improvement in their learning as a result of using the website and app, and 3) find out whether or not students' felt that classes should be supported with this type of technology in the future. With this questionnaire the researcher was able to obtain information that would further improve the website and the app and evaluate whether or not this type of learning strategy should be used in other modules. The second phase of the assessment process was considered of great importance for this study as it allowed the researcher gain alternative views on the website and

the app from the lecturing team in Economics/Finance. In this way, it was possible to obtain objective information from the academic community that would enrich the data gathered.

Research Sample Analysis

The proposed study was carried out in the 2010/11 academic year with a sample of ten students attending the MSc in Finance at DIT. The sample selection was based on the following criteria: 1) students should attend classes regularly and be aware of the material that is covered during the course. 2) Students should be familiar with the econometrics software and its role in the module. 3) Students should be able to address basic issues in econometrics and understand how mobile technologies can be used to support their learning process. The sample selection was based on these criteria as the researcher wanted to avoid any bias derived from students that were frequently absent from the classroom and do not have the skills to provide a reliable assessment of the learning material created by the researcher. The sample of postgraduate students finally selected was deemed optimal as they attend classes regularly and have the basic skills to assess the learning website and app designed for the module. It was anticipated that feedback and assistance could be provided to this group when needed as interaction with them was good. Moreover, adjustments to the research process would be possible when considered appropriate. Finally, it would be easy to overcome issues related to the access of the mobile devices used on this study in view of the fact that the researcher was working with this group of students during the whole academic year.

Data Collection Methods

This study used both qualitative (participant observation) and quantitative (questionnaires) data collection methods. Qualitative research is appropriate for researchers who seek to understand, rather than explain or predict behavior (Hogan, Dolan, & Donnelly, 2009). It is a particularly useful method when the issue under investigation is in its infancy. In qualitative research it is important that the researcher is sensitive to the perspectives of the participants in the study (Morehouse, 2011; Saldaña, 2009). In this way, purposive samples can provide useful descriptive data. Random data, on the other hand, are useful when a researcher seeks to explain or predict something, rather than describe its nature (Bloomberg, 2008). Taking this into account, this study used observational methods at different stages of the project, as the iPad is a device that has only recently been introduced to the market. Therefore, important limitations with regard to the possibility of drawing comparisons with other research were present.

Observational techniques were considered appropriate for this research project, as they are useful for a wide range of research problems in social sciences. Jorgensen (1989, p. 13) suggested that observational techniques can be effectively used to collect in-depth information, as this approach provides rich insights into the participants' reactions. In addition, this technique can be considered sensitive to the analytical environment as it gives the researcher access to the assessment of a situation where little knowledge exists, as is the case for this project where the iPad was tested in a financial environment.

The data collection analysis took into account the disadvantages of using observational techniques in this study, which can be identified as follows: 1) Reliability tends to be lower

when data is gathered via observational techniques, as two people do not see the world in exactly the same way; each individual has different preconceptions, prejudices and preferences. Therefore, each person will interpret what they see differently. 2) Another aspect to consider was the validity of this study. Validity tends to be lower when using the observational paradigm as the observer impressions might be subject to his/her
own interpretations.

In order to minimize the drawbacks associated with observational methods, two different groups were targeted: students and lecturers. In addition, structured and unstructured questionnaires were used to supplement and support the data collection process. The study began with a direct interaction between the researcher and her respondent groups (students and lecturers). The main objective was to identify students' and lecturers' views on mobile learning and the use of mobile devices to support the finance discipline. Structured questionnaires were also designed to provide an appropriate structure to the research process and to try to minimise the variability of responses obtained from the unstructured interviews. Therefore, participants (students and lecturers) were asked to complete a final questionnaire designed to assess their learning experience. This questionnaire was voluntary and anonymous in order to preserve participants' rights and to comply with DIT ethics policies.

Research Design

Case study. Qualitative case studies provide researchers with the tools to explore complex phenomena, and can be used to improve our understanding of how teachers can develop and implement teaching techniques that enhance students' learning experience. According to Baxter and Jack (2008):

> Case-study research is more than simply conducting research on a single individual or situation: a case study has the potential to incorporate aspects of both simple and complex situations. It enables the researcher to answer "how" and "why" type questions, while taking into consideration how a phenomenon is influenced by the context in which it is situated. (p. 556).

In addition, and with the aim to strengthen the research findings, it was deemed appropriate to combine a number of research methods. Consequently, the concept of "triangulation" comes into its own, as this type of approach is characterized by the act of combining several research methods to study a particular issue (Kennedy, 2009). Densin (1978; as cited in Jick, 1979) defined triangulation as "the combination of methodologies in the study of the same phenomenon." Thus, through the combination of a case study based on observational methods that were supported by structured and unstructured interviews that target sample groups, the researcher was able to find a balance that helped provide rich and meaningful results.

The present case study is based on a group of 22 postgraduate students (during the second semester of the academic year 2010-11 as outlined above) undertaking the MSc in Finance at DIT. Mobile technologies were introduced to support lectures during a period of one month with the aim of exploring whether this tool would help to enhance students' learning in econometrics. The sample used for the case study was chosen out of previous experience: the author has taught econometrics at different levels in the Institute postgraduate programs for four years (September, 2008 to May, 2011). During this time it was observed that students' participation and understanding during classes was very low. The majority of students experienced problems following class discussions and adjusting to the new material being presented week after week. This lack of interaction and low performance among the students was a clear sign that there was a problem with the module as well as with the teaching technique used by the lecturer. It became apparent that something needed to be done to reduce the belief that Econometrics is a difficult subject, one which is hard to follow and understand. It was important to find a way to motivate students and generate interest in the subject.

After teaching this module for quite a long time the researcher found clear evidence that the students tended to struggle with the course material, and were limited in their application of basic concepts. It was also discovered that, in general, students undertaking this module showed poor critical thinking skills when dealing with financial and economic issues. This has translated into poor results on their assignments and final exam. Consequently, the author of this study considered it appropriate to develop a learning artefact (website and app) that would address these issues by supporting the students' ability to learn anywhere, anytime. The main idea was to create a personalized application that could be used by students in their own time, without any kind of pressure or imposed requirement.

Learning artifact. This research project was supported by the creation of a learning artifact that combined two approaches: a website and an app to be used on an iPad. The website was designed to support class material and could be accessed by students from their computers or mobile devices. The website was structured with a front page that provides basic details on econometrics theory and modeling. Links and tabs that gave the user access to the theoretical material, tutorials and video demos were shown on the front page. In addition, secondary web pages were developed to organize and support all the individual lessons that students should cover to gain a basic understanding on econometrics. An app was designed to support and add value to the website. The aim of the app was to facilitate alternative access to the learning material on the website using an iPad.

The process of developing the website and app was quite laborious and took a significant amount of time and resources. This is important to highlight as it raises issues with regard to the feasibility of using these types of teaching approach in higher education. In addition, taking into account the current economic climate, lecturers face limitations with regard to the technologies, gadgets, etc., that can be purchased to support their teaching programs. As higher education is affected by major cuts with regard to staff and resources, it seems that this type of teaching and learning approach might not be considered efficient in the present economic climate.

Research Findings

This section provides some general comments on the research main outcomes of this study. The initial phase of this analysis lasted for nine months, during which time the researcher created the learning material (lecture notes, the website and app) to evaluate the use of the new technologies in postgraduate courses in the area of finance. Once the material was completed, students and lecturers were able to interact with the website over a period of one month, and with the app for seven days. It was considered that this time frame allowed all participants to interact with the learning material long enough to be able to conduct an appropriate assessment of it.

The main findings are divided into two sections: Firstly, the results obtained from the students' assessment of the website and the app is briefly discussed. Secondly, the results from the lecturers' evaluation of the website and the app are presented.

Student Results

The main findings of this study are based on the assessment provided by a sample of seven students undertaking the MSc in Finance at DIT. As ten students were initially approached and only seven chose to do so, we had a participation rate of 70%. The results showed that all students that participated in this project owned a mobile phone. This is an important result and was used by the researcher to further explore the type of technology used by the sampled students. The results showed that 57.14% of the students did not own a smart phone, while 42.86% did. This is an important limitation with regard to the use of latest technologies to support students' learning, as it might be that not all of them are able to afford the required technology used to support the course.

Overall, the answers provided by the students to the distributed questionnaire that participated in this study assessing the benefits of mobile learning in finance have been very helpful and encouraging. The results from the student questionnaire have identified important limitations with regard to the use of technologies to support student learning. For instance, it is important to highlight the limited access that some students have with regard to newest technologies and devices. On the other hand, this study has identified great potential with regard to the use of mobile technologies and their integration into postgraduate classes, and that students are very receptive to ICT and their role in education. In addition, students' assessment of the website and app created by the researcher has been very positive; it is clear that this type of resource adds value to the students' learning process. As a result, new technologies should be considered useful as a teaching support and, if possible, should be used by lecturers in their teaching routines.

The results from the students' evaluation suggest that the learning artifact created was an effective tool for changing the class dynamics, as it provided an alternative to the traditional learning approach where students assumed a very passive attitude. Overall, the use of mobile technologies helped provide an environment where students were more relaxed and less apprehensive. In general, the majority of students that participated in this project enjoyed the

experience and considered that a website would add value to their learning, as they would be able to access the material "anywhere" and at "anytime" they chose.

In terms of improving or motivating students' critical thinking skills, the results were not conclusive as the project took part during the second semester of the course and it was not possible to assess whether the artifact contributed to the improvement of these skills.

Academic Staff Results

In general, the lecturers that took part on this project agreed that the website and the app provided a refresher course in basic econometrics and showed the student how to use Eviews. It was highlighted by one of the lecturers that the website and app helped build on students' learning. For instance, one lecturer stated that "the term scaffolding- learning process is very apt particularly in relation to the Eviews section – the material is built in a logical fashion and it provides the means to access much more uses/applications of Eviews." In addition, the lecturers concluded that the use of the website, combined with PC tables, smart phones, or any appropriate mobile technology would allow for greater flexibility, better scope for interaction among students, and more time for reflection on the course material. Furthermore, it was considered that the project allowed for a review/rethink of what lecturers in economics/finance are doing in their classrooms and in particular how teaching and learning is being developed.

To conclude, this study has provided evidence for the role of mobile technologies in higher education Institutions and how professionals in the educational sector need to be aware of the role of ICT and mobile technologies in the classroom. In line with Friedman (2005), the key drivers for success include economic competition and technological advances. Hence, the educational system needs to adjust by integrating new technologies into their program structures and training if they do not want to be left behind.

Conclusions, Limitations and Further Research

The present study explored the use of mobile technologies inside and outside the classroom as a way of promoting and developing independent learning and critical thinking skills in students undertaking postgraduate courses in economics and/or finance. The case study comprised students attending an MSc in Finance at DIT where econometrics is a major component, as well as lecturers in economics and finance that offered their views on the learning artifact.

The results of this study clearly support the use of mobile technologies in the classroom; mobile technologies can encourage and motivate self-directed learning making the learning process more enjoyable and interesting for students. Overall, students and lecturers recommended the use of mobile technologies to support classes. On the other hand, this study highlighted some potential problems with the use of technology in the classroom, as the introduction of new technology may lead students becoming distracted from the actual course material under study. This finding is consistent with Pew's (2007) study which highlighted that is quite common that inappropriate teaching methods are used in higher education. In

particular, Pew argued that it's possible that the use of technology in the classroom diverts attention away from the key activities that the teacher and the students should be concentrating on. As a result, the course interest can lie in the technological aspects of the course rather than in the designed content.

The present study provides some encouraging evidence that mLearning has an important role to play in higher education, with the potential of changing the dynamics in the learning environment, supporting active learning in the classroom, and encouraging self-directed learning outside of it. However, it is still unclear as to whether these types of technologies are an effective means of encouraging and promoting autonomous learning. This study did not include an assessment of whether students' analytical skills, critical thinking skills, application of financial data, and exam performance improved as a result of using mobile technologies to support the learning experience.

Study Limitations

A number of limitations were identified on this project: Firstly, this study was concerned with the use of three different learning and teaching methods (a website, an app and traditional teaching) of supporting academic performance with the same sample of students over one semester without using a control group. The use of mobile technologies and a learning artifact were introduced during the second semester of the academic year 2010/11, when students were already receiving feedback and instruction in relation to their work in econometrics. This meant that a learning process had already taken place, and it was not possible to ascertain the extent of the effect that mobile technologies had on students' performance. A second aspect to be considered is the teacher's inexperience in using these devices and technologies to support teaching, which may have also impeded their full potential. In addition, the teacher had to monitor and provide support to help students understand the learning tools and it is possible that this influenced the students' learning process and assessment of the tools. Moreover, an in line with Kukulska-Hume (2009) and Harris (2009), there are important points to consider if we are to achieve success in this domain: i) the students' and teachers' "real" literacy in ICT and how to integrate it in their learning and teaching. ii) the cost associated with adjusting the classroom to the continuous advances and progress in new technologies. iii) time constraints associated with teachers' other work responsibilities (i.e., teaching, office hours, administrative duties, research, etc.). These issues need to be considered in order to draw robust conclusions on the potential of mobile technologies to improve the learning experience.

Further Research

Taking into account the points discussed above, it is clear that further research is necessary to assess the "real" potential of mobile technologies to improve and motivate students' learning in econometrics. Future research should explore strategies of integrating the type of learning artifact developed in this study as a tool to be integrated in the classroom in a way that is effective and efficient, rather than using it solely to help relax the classroom atmosphere. Future research should consider using a sample of students who have had little exposure to econometrics. Moreover, future research should explore how to manage and integrate these devices in the classroom in order to minimize distraction and maximize learning, a point

highlighted by Banister (2010). Another issue suggested by Peters (2007) is how the limitations that age, ability, and time can affect the teacher's ability to integrate these technologies in their teaching routines. An investigation of these factors will further our understanding as to whether the introduction of new technologies in the classroom is viable.

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