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Language Learning through Handheld Gaming: a Case Study of an English Course with Engineering Students

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Abstract: The 21st century is the generation of Digital Game-Based Learning, a generation growing up with technologies and contributing to the prevalence of digital games [Chuang et al., 10]. Thus, the use of mobile consoles (Nintendo DS or SONY PSP) for entertainment at all ages has increased dramatically, as has the availability of games that meet specific needs, requirements or users preferences. Though this field of applications is not exempt from constraints such as connectivity, usability and technical limitations [Moses, 08; Hussain and Adeeb, 09], mobile learning is now on the agenda at all levels of education [Cheon et al., 12; Frohberg et al., 09; Suki and Suki, 07]. In this study we analyze how Nintendo mobile technology used to teach vocabulary, grammar, pronunciation, writing and listening skills can help to improve the learning environment and the results in English for Engineering students. The two-fold investigation aims to (1) evaluate the student's satisfaction with mobile technology and (2) measure student learning with Nintendo DS. In the light of these hypotheses, the results show how the introduction of mobile devices can increase students' interest and motivation in the learning process, fostering the integration of activities and increasing the academic performance of students.

Keywords: Mobile language learning, Mobile consoles, L2 learning, motivation, Higher education
Categories: L.5.1, L.3.6, L.1.5

1 Introduction

The technological revolution we are witnessing is changing the rules of human relations, leisure, labour, and even education. Handheld devices are an example of this ongoing technological revolution [Looi et al., 09], due to the ubiquitous availability, the increase in motivation [Sorensen and Meyer, 07], the integration of Web 2.0 tools and the application of social-constructivist pedagogies [Cochrane and Bateman, 10]. There are a wide variety of different devices classified as handheld or mobile (Smartphones, tablets, netbooks and mobile consoles, among others) that people can use every day and everywhere. However , according to [Norris and

Soloway 13], the term mobile is restricted to those devices which are used while one is moving such as tablets, consoles and smartphones, criteria which exclude laptops, for instance, from this general category [Oulasvirta et al., 12],

> *Transportable, portable, mobile, schmobile — what's the big deal? Why is labeling a computing device as a mobile computing device even important? Is this merely a question of semantics, of academic wordplay or a question of substance, of practical importance to K-12 classrooms? The latter, absolutely [Norris and Soloway, 13, p.1].*

Besides, though mobile learning is on the agenda at all levels of education [Cheon et al., 12; Frohberg et al., 09; Suki and Suki, 07; Gikas and Grant, 13; Slovacek et al., 14; Sollervall and Milrad, 12; Zurita et al., 07], the surprisingly widespread use of mobile devices is not exempt from constraints such as connectivity, usability and technical limitations [Moses, 08; Hussain and Adeeb, 09].

These drawbacks aside, mobile consoles can include educational games with pedagogical objectives, social capabilities [Kovacevic and Opic, 14; Szentgyorgyi et al., 08] and motivational enhancement to improve the learning process [Chinnery, 06; Kukulska-Hulme, 09]. In the case of Nintendo DS, the device under study, there are studies that support the pedagogical dimension of the console [Bunce, 10; Gelman, 10; Larraza-Mendiluze et al., 12].

Therefore, our proposal starts by presenting some of the theoretical premises on which mobile and game-based learning are based, followed by a description of the device and the game used in our research. This two-fold investigation aims to (1) evaluate the student's satisfaction with mobile technology (engineering students enrolled in the course English in Computing) in a preliminary phase and (2) measure student learning with Nintendo in a second step conducted in two consecutive academic years.

2 Mobile Learning

M-learning, or mobile e-learning, is based on teaching /learning proposals that take place through any type of mobile device, whether smart phones, PDAs, consoles, tablet PCs, iPad[Dhir et al., 13] or any other that provides wireless connectivity and can be used while moving. The increasing use of this technology has led to the development of parallel systems of mobile learning at all educational levels [Frohberg et al., 09; Suki and Suki, 07] as a complimentary means to increase student and instructor social interaction, motivation and learning. [Zurita and Nussbaum, 07] and [Motiwalla, 07] found that students of the 21st century view m-learning as an important supplementary role to e-learning. [Fisher and Baird, 07] believe that mobile technology creates both community generated content and a community of learners and, leading to a more communicative and interactive setting rather than a content based setting. Some other advantages of mobile learning could be summarized as follows:

- Ubiquitous learning. Handheld devices allow anywhere/anytime possibilities for learning.
- Learning though rich media combining video, images and audio materials.
- Potential for location based learning. This means the phone can alert the person when they are near a potential learning experience.

The 2011 Horizon Report [Johnson et al., 11], produced by New Media Consortium (NMC), EDUCASE Learning Initiative (ELI) and Consortium for School Networking (CoSN), identifies emerging technologies and their impact on university education. According to the report, mobile devices and emerging technology for teaching and learning are already a reality in themselves, as evidenced by the existence of numerous applications for self-study, reference, practical exercises, fieldwork and research in hundreds of disciplines. Some of the challenges presented by this scenario include:

- Which devices are most popular with the target population and can technologically meet their needs best?
- Interface richness/immersiveness and how it performs compared to more traditional options like desktop/laptop PCs.
- A massive access to mobile information may tempt learners to abandon more traditional proposals or reduce time dedicated to deep reflection.

In the light of the above premises, mobile learning has become a topic of discussion at all levels of education [Cabot et al., 14; Drigas et al., 14; Frohberg et al., 09; Suki and Suki, 07; Gikas and Grant, 13], identifying a lot of advantages like enhanced learning through ubiquity, motivation, interaction and collaboration [Sergio, 12; Valk et al., 10] but also limitations that must be taken into account, such as connectivity, usability and technical limitations [Moses, 08; Hussain and Adeeb, 09]. One of the main problems to the successful integration of mobile learning in education is the usability since mobile devices have many specific usability issues which are not always taken into account [Deegan and Rothwell, 10]. In this context, a big effort has also been made to figure out how mobile technologies relate to both traditional and innovative ways of teaching and learning, demonstrating the applicability of mobile approaches across a wide range of activities and educational contexts [Naismith et al., 04; Kukulska-Hulme et al., 05; Sarrab et al., 13].

Within the classroom, it has been recognized that mobile devices, provided with appropriate software, can be highly effective in supporting autonomous, individual and collaborative teaching practices [Zurita, 04; Valdivia and Nussbaum, 07]. Although mobility may not be the key feature when using mobile devices within the classroom, conversation, interaction, decision-making between members of a group and physical movement can be difficult to achieve with the use of fixed computers. Outside the classroom, mobile and wireless technologies allow learning to be more directly connected with real world experience and contexts. The MANOLO project [Kukulska-Hulme and Traxler, 07] demonstrated the advantages of using handheld computers for university-level fieldwork in subjects such as archaeology and environmental sciences. In addition, games, in and outside the classroom, can increase learner motivation if they incorporate educational design appropriately [Sorensen and Meyer, 07] that helps to improve levels of attention, involvement and consequently learning.

In the case of language learning, it is necessary to differentiate mobile language learning from computer-assisted language learning, since the former comprises portable devices that facilitate new ways of learning, emphasizing spontaneity and interaction across different contexts of use. Although most methodological approaches encourage learners to follow teachers' guidance in the learning process

and there is little published evidence of approaches that are not teacher led, mobile learning seems to belong more to learners than to teachers.

George Chinnery [Chinnery, 06] surveyed the state of mobile language learning. [Kukulska-Hulme and Shield, 08] presented a review of publications reporting mobile-assisted language learning (MALL) and discovered how far mobile devices are being used to support social contact and collaborative learning. [Cortez et al., 11] explored new possibilities for MALL using 3G tools integrated in smartphones and tablets. [Miangah and Nezarat, 12] tried to demonstrate the benefits of using mobile phones in learning English (vocabulary, listening, grammar, phonetics, and reading comprehension) as a second language. An example of learner-led mobile language learning activity is reported by [Song and Fox, 08], who tracked advanced learners of English to see how they were using a mobile device to support and extend their learning in self-directed ways, especially to build their knowledge of vocabulary. The study shows how a mobile device helped them to communicate about word meanings with other students and with their lecturers outside the classroom.

2.1 Game-based Learning

Game Based Learning (GBL) aims at improving the quality of student learning through the use of video games, thus enhancing performance and strengthening the knowledge acquired by employing a playful and motivating experience. There are numerous studies that advocate the benefits of games as excellent educational tools, from which we can draw the following conclusions [Avouris and Yiannoutsou, 12; Chua and Balkunje, 12; Cortez et al., 11; Fonseca et al., 12; Gürbüz et al., 14; Padilla-Zea et al., 13; Peterson, 10; Slovaček et al., 14]:

- The students who used video games significantly increased reading comprehension ability.
- Video games offer learning environments based on discovery and creativity.
- Video games are an encouragement mechanism for children, which facilitate the learning process and greatly increase attendance.
- Video games increase the attention of students and their concentration at solving a particular problem because of its playful nature.

Consequently games offer an environment where learning occurs as a result of tasks stimulated by the contents of the game, the ubiquity of process and the cognitive abilities developed as a result of the act of playing.

When it comes to learning through consoles, Nintendo is the manufacturer that has positioned itself as the leader in this new trend, harnessing the potential of their competitors (Nintendo Wii at home and Nintendo DS family handheld video game systems) to support or develop games that activate the mind, expand vocabulary and to learn a language while users are having fun. A Nintendo DS family handheld console can be used as a tool for learning English through specific language learning games such as English Training, Practise English, Mind your language, English Buddy, Do you speak English?, My English coach. In fact, a recent study [Kondo et al., 12] uses Nintendo DS trying to help to improve students' scores on the TOEIC tests, research that concludes that students can improve their self-study behaviour with the use of the mobile console. They also improved their English and spent more time on studying outside of class.

For our study, we have chosen *Practise English*, a game that combines motivation and educational capabilities due to its usability and connectivity. One of the main features of the Nintendo DS is the touch-screen, used to test writing skills, dictation exercises given to students to be transcribed into English, and phrases provided to identify mistakes in spelling and grammar. It also features voice-recognition functions, requesting the users to read specific phrases aloud, and then ranks their performance onto a progress chart that allows users to keep track of their development and see their improvement over time. In addition, the software includes competitive games, English word tests, dictation and sound identification [Rico *et al.,* 08].

3 The study

3.1 Research questions

In general, terms our research aims to study how mobile technology can help to create a more dynamic learning environment for an English course for computer engineering students both in and out of the classroom. The research questions posed are as follows:

- Evaluate the student's satisfaction with mobile technology (Nintendo DS) which involves two related objectives -Preliminary study (2010-11):
    - Identifying variables to measure student satisfaction with mobile technology for language learning and how Nintendo DS is viewed
    - Gaining insight into the overall role of Nintendo in language acquisition in order to carry out further research in this field.
- Measure students' learning after six weeks with a Nintendo DS.

3.2 Practise English: Game Description

Nintendo's Practise English could be described as a handheld game that offers a variety of everyday situations that users may face in order to review their previous knowledge and to improve their language skills. The content is based on real situations with specific vocabulary such as meeting someone in a restaurant or a shop. Thus, the main purpose of this game is to make English accessible to everybody by offering short interactions, daily tasks, exams for each level, reviewing activities, as well as other more specific tasks focused on grammar, vocabulary and syntax, which is a perfect way to keep learners motivated and learning. Not aimed at complete beginners but to students who want to revise specific aspects by means of entertaining games, Practise English attempts to cover different levels of English proficiency and reflects an increasing level of difficulty.

In addition to the above-mentioned tasks, the exams present a well-defined template. The first part comprises four dictation activities and a listening comprehension as a final task. The former consists of transcribing words or sentences and when the correct answer is given, the game provides a syntactic explanation. The latter consists of a complete conversation followed by comprehension questions.

One of the more limited aspects of the game is the quality of the audio and given this is a portable console that can be used in inappropriate situations and contexts such as the underground, the bus or even in shared spaces at home, it is often

necessary to use headphones. The wide variety of sounds, sentences, words, conversations, and sound effects allow the listener to experience a realistic phone conversation.

3.3 Design of the study

The study was conducted in two phases during the academic years 2010-11 (first phase), 2011-12 and 2012-13 (second phase) with more than 50 students enrolled in English in Computing, an optional subject that forms part of a B. Eng in Computer Science degree. Though language levels within the group vary from A2 to B2 according to the Common European Framework for second language learning, most of them are lower-intermediate students (between A2+/B1).

As mentioned above, Nintendo DS was the console used for the experiment and Practice English the game, a game that is not intended for people who have no knowledge of English, but reinforces prior knowledge and includes ten levels of language content in a wide range of situations. Each level is divided into three parts, each of increasing difficulty, and comprised of about 20 exercises per section, almost 400 exercises in total. It also includes songs, tongue twisters, and revision that cover exercises previously completed incorrectly.

4 Data collection and Analysis

4.1 Research questions 1: motivation/attitude and effectiveness evaluation

During the 2010-11 academic year, we started the Nintendo DS and Practice English project with 18 engineering students. The aim of the first phase of the study was to measure students' general satisfaction with this kind of devices and to determine whether mobile technology could help our students improve their English and create a learning environment where the technology would be motivating enough to enhance student performance (satisfaction in terms of students' motivation, attitude towards the product and perception of effectiveness). This group worked on homework exercises with the Nintendo outside the classroom for a minimum of 2 hours per week for 15 weeks of the year (semester), completing a minimum of 30 hours of exposure to Nintendo.

After using the console, each student filled in a self-made questionnaire about motivation/attitude (annex I) and their opinion about the effectiveness of Nintendo DS and Practice English for language learning. Therefore at this stage an inductive methodology was employed in which data and findings were interpreted in light of the students' responses.

4.1.1 Motivation/attitude

Departing from the assumption that motivation is a key factor in learning, in figure 1 we show the percentage of students' answers to the first set of questions (see annex I) related to their previous experience with Nintendo, the challenge the games presented, the attitude towards learning language through this type of devices and whether they find both the device and the game easy or confusing (first sub-objective : Identifying

variables to measure student satisfaction with mobile technology for language learning and how Nintendo DS is viewed).

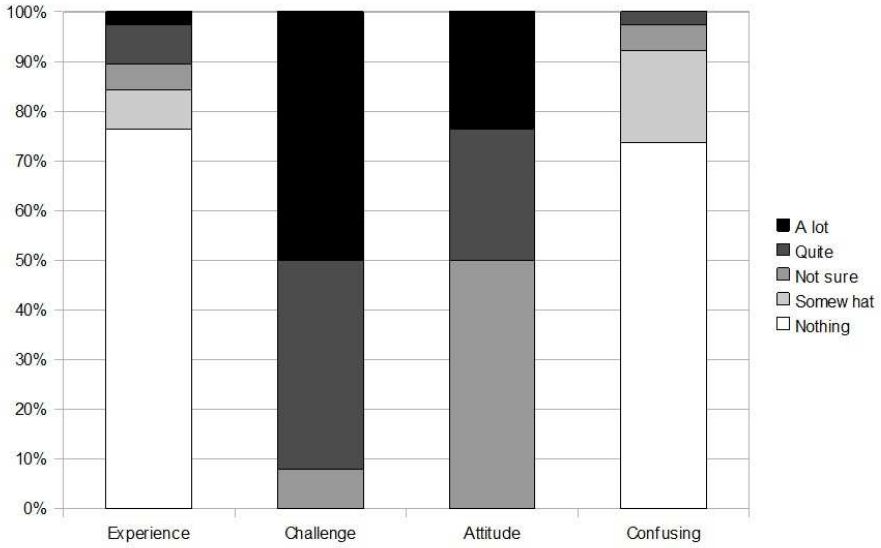

Figure 1: Motivation/Attitude results 1

It can be seen that 83.3% of students didn't have any prior experience with language learning through the Nintendo DS (Question 1) and that 100% (A lot, 44.4%; Quite, 55.6%) enjoyed the challenge of working with the console (Question 2). These data show that in general the students are initially motivated and have no previous experience with the Practise English game. On the other hand, around 44.4% aren't sure whether their willingness towards learning English through technology has increased with Nintendo DS.

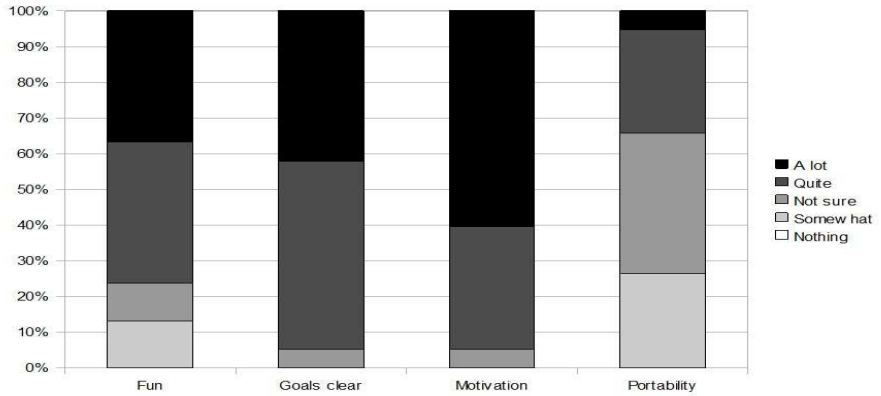

Figure 2: Motivation/Attitude results 2

Research indicates that gaming and the portability of mobile technology can positively affect student motivation, engagement and interest in language learning. In our case, the students surveyed thought that Nintendo DS made learning more fun, kept them engaged through continuous activity and allowed them to continue learning beyond the traditional classroom, increasing flexibility and offering new opportunities for interaction.

4.1.2 Effectiveness

The second sub-objective of this preliminary study is aimed at exploring students' opinions of the overall role and effectiveness of Nintendo in language acquisition. The survey shows students' perceptions of the value of mobile technology for working on specific language-learning skills and finds high levels of satisfaction with the vocabulary, pronunciation, grammar, and listening activities (Fig. 3) but lower results for the productive skills speaking and writing.

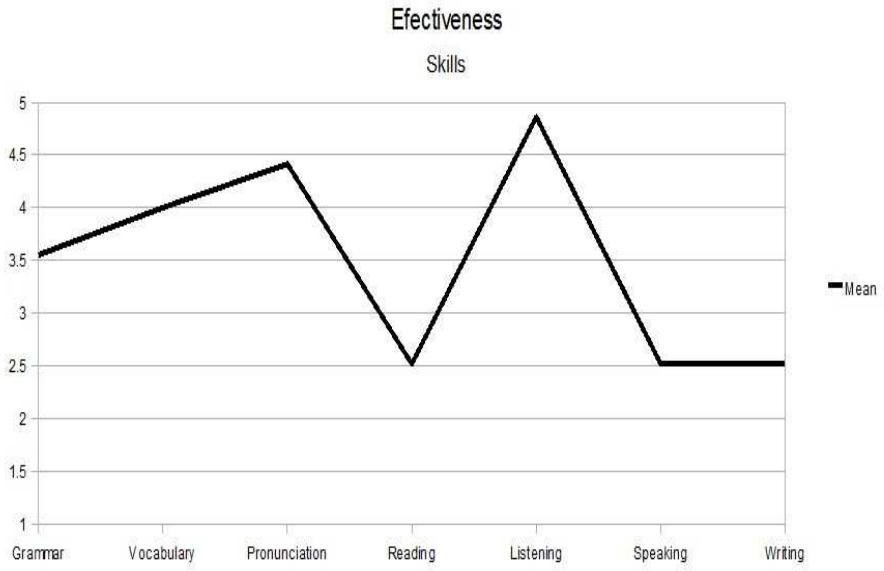

Figure 3: Effectiveness (skills)

The measure of student perceptions of the value of mobile technology for improving communicative language-learning skills produced interesting results as seen in figure 4: 2.5 out of 5 in the case of adequacy to develop communicative abilities, 2 out of 5 for increasing learner confidence and 3.3 out of 5 in the case of effectiveness in delivering language content.

The challenging part of this research is trying to determine how mobile technology can help Engineering students be more confident with their English and create a communicative and efficient environment to learn in which the technology enhances student performance. However, sampling over a longer time span is needed

to obtain a more reliable measure of improvements in effective performance (objective 2).

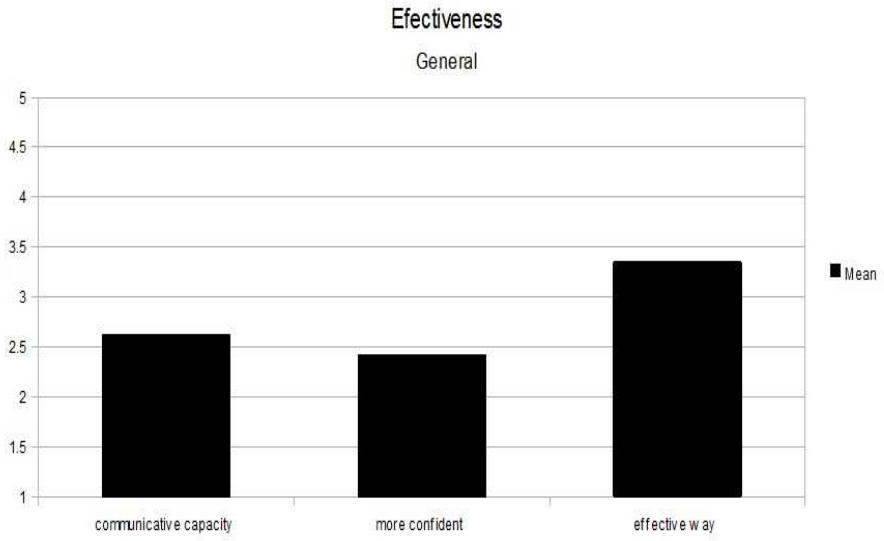

Figure 4: Effectiveness (general)

4.2 Objective 2: Language learning with Nintendo DS

In the second phase of our study (academic years 2011-12 and 2012-13), students used the Nintendo DS over six weeks outside the classroom to play wherever and whenever they wanted without any special guideline (see section 3.2 -game description).

We analyzed the interaction with the console of 38 students of the subject English in Computing using the game Practise English. Two exams were delivered before and after the experiment (pre-test /post-test) in order to analyze level and progress respectively. Both exams were designed by the language instructors and assessed the same type of content and skills (e.g. grammar, vocabulary, pronunciation, reading abilities, writing, listening and speaking). Although Practise English does not register the number of hours the software has been used, it does record the number of sessions and the days on which it is used; therefore, we used these data to observe whether the number of sessions affects the final result. Students were free to plan their study of English as they wished, however, the teachers recommended a minimum of 20 minutes per day and 4-5 days per week.

As can be seen in Table 1, the average time spent on the console was around 25 minutes, as recommended by the teachers.

	N	Minimum	Maximum	Mean	Std. Deviation
Days	38	5.00	20.00	10.00	3.79
Initial_test	38	2.90	8.80	5.49	2.02
Final_exam	38	2.22	9.85	5.98	2.43
Assesment_per_day	38	8.71	54.13	25.92	13.75

Table 1: Descriptive statistics of days, initial test, final exam and number of assessment per day

Likewise, the number of days the game was used by the students varies, between 5 and 20 days depending on the participant and the average is 10 days per student. Table I shows the descriptive statistics of the variables under consideration in this section: number of days, initial test marks, final exam marks and number of assessment per day with the game. For the initial test and final exam the marks mean are 5.49 and 5.98 respectively. When applying the students' t-Test, we can observe a significant difference ($t = -3.488$ and $p<0.01$), rate which may not be enough to state whether it is determined by the usage of Nintendo or by the learning process itself.

In order to analyze the results more in detail, in Fig. 5 the students marks have been ordered according to their daily use of the console. This shows that although there is a connection between low marks and less time dedicated to playing the game, there are also students who dedicated more time to the game yet still received low marks. On the other hand, as you can see, the grey line (Initial test) is normally a little below the black line (Final exam) when students use the Nintendo DS 9 days or more. However, for usage less than 9 days the black line tends to be below grey line. Therefore, there is a constant tendency showing that more time spent playing the game leads to better results.

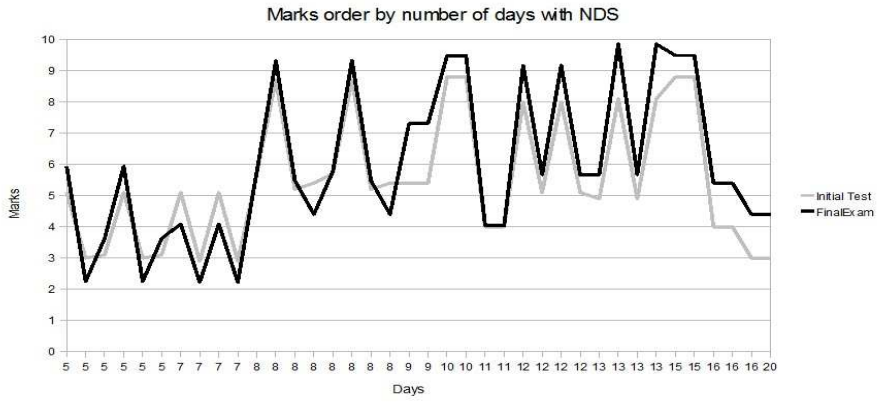

Figure 5: Marks order by number of days with NDS

To observe this question better, if the differences between the pre-test exam grade and the final exam grade are considered (Fig. 6) it can be seen that the students who dedicated 9 days or more to the game increased their final grade, some more than

others. This implies that more time spent playing the game means more time spent covering the contents of the subject that in turn leads to a higher final grade.

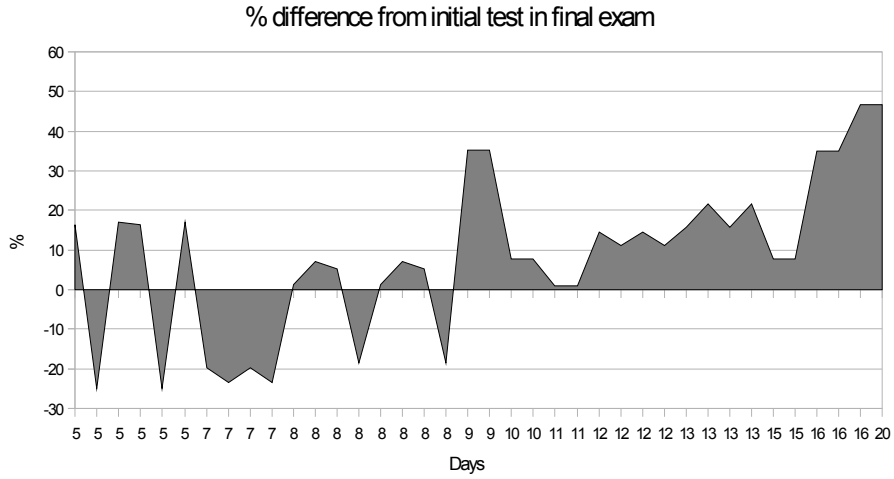

Figure 6: Percentage of difference form initial test in final exam

From a statistical point of view (Table 2) and regarding the students who spent less time playing the game, there is no a clear correlation among variables since some of those students improved their final grade ($p>0,05$). Therefore the use of the game helped students to improve their final marks ($p<0,01$) when exposed to a 9 or more days program, perhaps not only by the game itself but by the appeal which may lead them to dedicate more time to Practise English, an additional evidence which could show the motivation increase.

	Days	**N**	**Mean**	**Std. Deviation**	**t**	**Sig.**
Initial_test	>= 9.00	20	6.0100	2.13908	1.717	0.095
	< 9.00	18	4.9111	1.76064		
Final_exam	>= 9.00	20	7.0480	2.22129	3.194**	0.003**
	< 9.00	18	4.7900	2.12392		

Table 2: t-Test of less than 9 days and 9 days or more use for initial test and final exam

We also analyzed the language level assigned to users by the game in the first session, observing that this initial assessment tends to place students in a lower than deserved band, presumably to motivate users to continue playing the game in subsequent sessions. In figure 6 we can see that with 8 or more days of use, the students normally advance several levels higher (Figure 7).

The use of mobile devices turns out to be well aligned with strategic educational goals such as improving student retention and achievement and reaching learners who would not otherwise have the opportunity to participate in education outside the classroom [Kukulska-Hulme et al., 05].

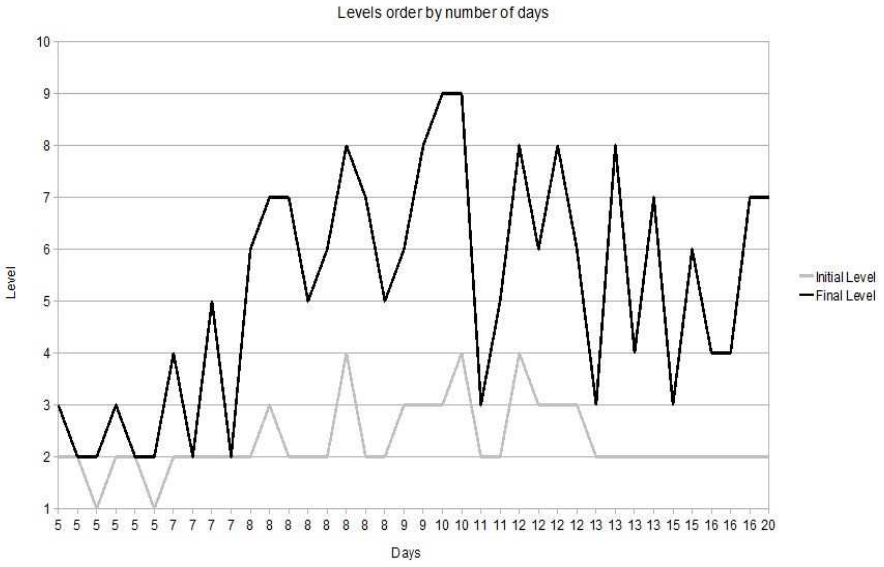

Figure 7: Game levels per student

5 Conclusions

As learners are increasingly knowledgeable individuals and technologically literate, it is important to meet their expectations regarding access to information and new opportunities for learning. Therefore, there is a growing interest in studying how ICTs (Information and Communication Technologies) are embedded in educational practices and how they can transform and improve them. Based on the objectives, the research aimed to demonstrate two hypotheses. Firstly, it was our purpose to analyze whether the introduction of mobile devices, specifically the Nintendo DS mobile console, would increase students' interest and motivation in the teaching and learning process and secondly, whether fostering the integration of activities and educational mini-games included in Practise English would increase the academic performance of students.

The results to the first goal indicates that the use of mobile technology increases learners' motivation, an idea proposed by [Swan et al., 05] who stated that when mobile computing devices were introduced into classrooms students and teachers alike observed an increase in motivation, leading to increases in both the quantity and quality of student work. This may be attributed to the use of educational mobile games that makes students experience the benefits of the console and the game and value their performance positively, especially when learning vocabulary, pronunciation and listening comprehension. However, the use of mobile devices per se does not guarantee learning, but the educational activities and usage patterns should be designed and integrated into the syllabus of the academic subjects to

improve students' academic performance. In this sense, the Nintendo DS and Practise English were introduced to students as an educational resource that can be used at any time outside the classroom setting. Although the students were not obliged to, they readily adapted to the Nintendo DS and followed the usage guidelines established by the teachers.

On the other hand, analyzing the outcomes from the second objective, we have come to the conclusion that students who spent nine or more sessions playing Practise English on the Nintendo DS could improve their academic performance in the acquisition of some of the English skills. The degree of improvement is related to the amount of time they are actively engaged to teaching/learning activities. However, it is important to note the inconsistency of results when a student spends less time playing the game, observing that their academic performance can vary either improving or getting worse, due to additional factors. The identification and study of these additional variables, what skills are needed to capitalize the wide range of tools available, provide an open field for future research.

Learning will move outside of the classroom becoming more personal, collaborative and lifelong. The challenge will be to discover how to use mobile technologies to transform learning into part of our daily life. A great deal of change is going on in teaching nowadays so the introduction of mobile learning should be seen in the context of change. Success is not guaranteed but the potential rewards make it worth exploring.

References

[Avouris and Yiannoutsou, 12] Avouris, N. and Yiannoutsou, N.: "A review of mobile location-based games for learning across physical and virtual spaces"; *Journal of Universal Computer Science, 18*(1)5, (2012), 2120–2142.

[Bunce, 10] Bunce, S.: "Can Nintendo DS Consoles Be Used for Collaboration and Inquiry-Based Learning in Schools?"; *Journal of the Research Center for Educational Technology,*(6)1, (2010), 172–184.

[Cabot *et al.,* 14] Cabot, A.G., Garcia-Lopez, E., de-Marcos, L. and Abraham-Curto, J.: "Adapting learning contents to mobile devices and context to improve students' learning performance: A case study"; *Journal of Universal Computer Science*, *20*(15), (2014), 2032–2042.

[Cheon *et al.,* 12] Cheon, J., Lee, S., Crooks, S.M. and Song, J.: "An investigation of mobile learning readiness in higher education based on the theory of planned behavior"; *Computers & Education, 59*(3), (2012), 1054–1064.

[Chinnery, 06] Chinnery, G.M.: "Going to the MALL: Mobile Assisted Language Learning"; *Language Learning & Technology, 10*(1), (2006), 9–16.

[Chua and Balkunje, 12] Chua, A.Y.K. and Balkunje, R.S.: "An exploratory study of game-based m-learning for software project management"; *Journal of Universal Computer Science*, *18*(14), (2012), 1933–1949.

[Chuang *et al.,* 10] Chuang, T.Y., Sub, S.H. and Tsao, Y.P.: "Using Handheld Gaming Device to Increase Multiple Intelligences with Digital Puzzle Game"; In *Proceedings of the 18th International Conference on Computers in Education (ICCE 2010)*. Putrajaya, Malaysia, (2010).

[Cochrane and Bateman, 10] Cochrane, T. and Bateman, R.: "Smartphones give you wings: Pedagogical affordances of mobile Web 2.0"; *Australasian Journal of Educational Technology, 26*(1), (2010), 1–14.

[Cortez, Roy and Vazhenin, 11] Cortez, R., Roy, D. and Vazhenin, A.: "Mobile Assisted Language Acquisition: An overview of the field and future opportunities based on 3G mobile capabilities"; *International Transactions on elearning & Usability, 2*(1), (2011), 4–6.

[Deegan and Rothwell, 10] Deegan, R. and Rothwell, P.: "A Classification of M-Learning Applications from a Usability Perspective"; *Journal of the Research Center for Educational Technology, 6*(1), (2010), 16–27.

[Dhir *et al.,* 13] Dhir, A., Gahwaji, N.M. and Nyman, G.: "The role of the iPad in the hands of the learner"; *Journal of Universal Computer Science, 19*(5), (2013), 706–727.

[Drigas *et al.,* 14] Drigas, A.S., Ioannidou, R.-E., Kokkalia, G. and Lytras, M.D.: "ICTs, mobile learning and social media to enhance learning for attention difficulties"; *Journal of Universal Computer Science, 20*(10), (2014), 1499–1510.

[Fisher and Baird, 07] Fisher, M. and Baird, D.E.: "Making mLearning Work: Utilizing Mobile Technology for Active Exploration, Collaboration, Assessment, and Reflection in Higher Education"; *Journal of Educational Technology Systems, 35*(1), (2007), 3–30.

[Fonseca *et al.,* 12] Fonseca, B. et al.: "PLAYER-a European project and a game to foster entrepreneurship education for young people"; *Journal of Universal Computer Science, 18*(1), (2012), 86–105.

[Frohberg *et al.,* 09] Frohberg, D., Goth, C. and Schwabe, G.: "Mobile Learning Projects--A Critical Analysis of the State of the Art*"; Journal of Computer Assisted Learning, 25*(4), (2009), 307–331.

[Gelman 10] Gelman, A.: *Mario Math with Millennials: The Impact of Playing the Nintendo DS on Student Achievement*. University of Denver, http://www.proquest.com/en-US/products/dissertations/individuals.shtml (2010).

[Gikas and Grant, 13] Gikas, J. and Grant, M.M.: "Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media"; *The Internet and Higher Education, 19*, (2013), 18–26.

[Gürbüz *et al.,* 14] Gürbüz, R., Erdem, E. and Uluat, B.: "Reflections from the process of game-based teaching of probability"; *Croatian Journal of Education, 16*(3), (2014), 109–131.

[Hussain and Adeeb, 09] Hussain, I. and Adeeb, M.A.: "Role of Mobile Technology in Promoting Campus-Wide Learning Environment"; *Turkish Online Journal of Educational Technology - TOJET, 8*(3), (2009), 48–56.

[Johnson *et al.,* 11] Johnson, L., Smith, R., Willis, H., Levine, A. and Haywood, K.: *The 2011 Horizon Report*; Austin, TX., The New Media Consortium (2011).

[Kondo *et al*, 12] Kondo, M., Ishikawa, Y., Smith, C., Sakamoto, K., Shimomura, H. and Wada, N.: "Mobile Assisted Language Learning in university EFL courses in Japan: developing attitudes and skills for self-regulated learning"; *ReCALL, 24*(2), (2012), 169–187.

[Kovacevic and Opic, 14] Kovacevic, T. and Opic, S.: "Contribution of Traditional Games to the Quality of Students' Relations and Frequency of Students' Socialization in Primary Education"; *Croatian Journal of Education-Hrvatski Casopis Za Odgoj I Obrazovanje, 16*, (2014), 95–112.

[Kukulska-Hulme, 09] Kukulska-Hulme, A.: "Will Mobile Learning Change Language Learning?"; *ReCALL, 21*(2), (2009), 157–165.

[Kukulska-Hulme *et al.,* 05] Kukulska-Hulme, A., Evans, D. and Traxler, J.: "Landscape Study in Wireless and Mobile Learning in the post-16 sector"; (2005), http://oro.open.ac.uk/43927/2/Landscape%20study%202005_all%20reports.pdf

[Kukulska-Hulme and Shield, 08] Kukulska-Hulme, A. and Shield, L.: "An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction"; *ReCALL, 20*(3), (2008), 271–289.

[Kukulska-Hulme and Traxler, 07] Kukulska-Hulme, A. and Traxler, J.: "Designing for mobile and wireless learning"; In H. Beetham & R. Sharpe (eds.) *Rethinking pedagogy for a digital age: Designing and delivering e-learning* (2007), London: Routledge, 180–192.

[Larraza-Mendiluze *et al.,* 12] Larraza-Mendiluze, E. et al.: "Nintendo DS projects to learn computer input-output"; In *Proceedings of the 17th ACM annual conference on Innovation and technology in computer science education*. ITiCSE '12. New York, NY: ACM (2012), 373–373.

[Looi *et al.,* 09] Looi, C.-K. et al.: "Anatomy of a mobilized lesson: Learning my way"; *Computers & Education, 53*(4), (2009), 1120–1132.

[Miangah and Nezarat, 12] Miangah, T.M. and Nezarat, A.: "Mobile-Assisted Language Learning"; *International Journal of Distributed and Parallel Systems, 3*(1), (2012), 309–319.

[Moses, 08] Moses, O.O.: "Improving Mobile Learning with Enhanced Shih's Model of Mobile Learning"; *US-China Education Review, 5*(11), (2008), 22–28.

[Motiwalla, 07] Motiwalla, L.F.: "Mobile Learning: A Framework and Evaluation"; *Computers & Education, 49,* (2007), 581–596.

[Naismith *et al.,* 04] Naismith, Lonsdale, P., Vavoula, G. and Sharples, M.: *Literature Review in Mobile Technologies and Learning*; Bristol, UK, NESTA FutureLab (2004).

[Norris and Soloway, 13] Norris, C. and Soloway, E.: "Is a Laptop a Mobile Computer? And Why Is That Even an Important Question?"; *THE Journal* (2013).

[Oulasvirta *et al.,* 12] Oulasvirta, A., Rattenbury, T., Ma, L. and Raita, E.: "Habits make smartphone use more pervasive*"; Personal and Ubiquitous Computing, 16*(1), (2012), 105–114.

[Padilla-Zea *et al.,* 13] Padilla-Zea, N., López-Arcos, J.R., González Sánchez, J.L., Gutiérrez Vela, F.L. and Abad-Arranz, A.: "A method to evaluate emotions in educational video games for children"; *Journal of Universal Computer Science, 19*(8), (2013), 1066–1085.

[Peterson, 10] Peterson, M.: "Computerized Games and Simulations in Computer-Assisted Language Learning: A Meta-Analysis of Research"; *Simulation & Gaming, 41*(1), (2010), 72–93.

[Rico *et al.,* 08] Rico, M., Agudo, J.E., Sánchez, H. and Curado, A.: "Language Learning in the Palm of Your Hand"; In *The 2nd IEEE International Conference on Digital Game and Intelligent Toy Enhanced learning*. The 2nd IEEE International Conference on Digital Game and Intelligent Toy Enhanced learning. Banff, Canada, IEEE Computer Society (2008), 113–115.

[Sarrab *et al.,* 13] Sarrab, M., Al-Shihi, H. and Hussain Rehman, O.M.: "Exploring Major Challenges and Benefits of M-learning Adoption*"; British Journal of Applied Science & Technology, 3*(4), (2013), 826–839.

[Sergio, 12] Sergio, F.: "10 Ways That Mobile Learning Will Revolutionize Education"; Co.Design (2012), http://www.fastcodesign.com/1669896/10-ways-that-mobile-learning-will-revolutionize-education

[Slovaček *et al.,* 14] Slovaček, K.A., Zovkić, N. and Ceković, A.: "Language games in early school age as a precondition for the development of good communicative skills"; *Croatian Journal of Education, 16(*1), (2014), 11–23.

[Sollervall and Milrad, 12] Sollervall, H. and Milrad, M.: "Theoretical and methodological considerations regarding the design of innovative mathematical learning activities with mobile technologies"; *International Journal of Mobile Learning and Organisation, 6*(2), (2012), 172–187.

[Song and Fox, 08] Song, Y. and Fox, R.: "Using PDA for Undergraduate Student Incidental Vocabulary Testing"; *ReCALL, 20*(3), (2008), 290–314.

[Sorensen and Meyer, 07] Sorensen, H.B. and Meyer, B.: "Serious Games in language learning and teaching - a theoretical perspective"; In B. Akira (ed.) *Situated Play: Proceedings of the 2007 Digital Games Research Association Conference*. Tokyo, The University of Tokyo (2007), 559–566.

[Suki and Suki, 07] Suki, N.M. and Suki, N.M.: "Mobile Phone Usage for M-Learning: Comparing Heavy and Light Mobile Phone Users"; *Campus-Wide Information Systems, 24*(5), (2007), 355–365.

[Swan *et al.,* 05] Swan, K., van't Hooft, M., Kratcoski, A. and Unger, D.: "Teaching and learning with mobile computing devices: Closing the gap"; In H. van der Merwe & T. Brown (eds.) *Mobile Technology: The Future of Learning in Your Hands, mLearn 2005*. mLearn 2005. Cape Town, (2005), 157–161.

[Szentgyorgyi *et al.,* 08] Szentgyorgyi, C., Terry, M. and Lank, E.: "Renegade gaming: practices surrounding social use of the Nintendo DS handheld gaming system"; In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '08. New York, NY, USA, ACM (2008), 1463–1472.

[Valdivia and Nussbaum, 07] Valdivia, R. and Nussbaum, M.: "Face-to-face collaborative learning in computer science classes"; *International Journal of Engineering Education, 23*(3), (2007), 434–440.

[Valk *et al.,* 10] Valk, J.-H., Rashid, A.T. and Elder, L.: "Using mobile phones to improve educational outcomes: An analysis of evidence from Asia"; *The International Review of Research in Open and Distance Learning, 11*(1), (2010), 117–140.

[Zurita, 04] Zurita, G.: "Computer supported collaborative learning using wirelessly interconnected handheld computers"; *Computers & Education, 42*, (2004), 289–314.

[Zurita *et al.,* 07] Zurita, G., Antunes, P., Baloian, N. and Baytelman, F.: "Mobile sensemaking: Exploring proximity and mobile applications in the classroom"; *Journal of Universal Computer Science, 13*(10), (2007), 1434–1448.

[Zurita and Nussbaum, 07] Zurita, G. and Nussbaum, M.: "A conceptual framework based on Activity Theory for mobile CSCL"; *British Journal of Educational Technology*, *38*(2), (2007), 211–235.

ANNEX 1

Questionnaire 1: Motivation /Attitude

(1) I have had previous experience with Nintendo DS for Language Learning A lot Quite Not sure somewhat Nothing
(2) Does the challenge of working with Nintendo DS appeal to you? A lot Quite Not sure somewhat Nothing
(3) My personal attitude towards learning English through technology has increased with Nintendo DS A lot Quite Not sure somewhat Nothing
(4) How Confusing do you find Nintendo DS? A lot Quite Not sure somewhat Nothing
(5) Do you think it is fun to use Nintendo DS for language learning? A lot Quite Not sure somewhat Nothing
(6) Are the teaching goals of using Nintendo DS clear? A lot Quite Not sure Somewhat Nothing
(7) Did using Nintendo during the class increase your motivation? A lot Quite Not sure somewhat Nothing
(8) Its portability has contributed to my English learning by taking advantage of my time during this experience A lot Quite Not sure somewhat Nothing
(9) Other (state further advantages /disadvantages)

Questionnaire 2: Effectivenes

Questions	Results
1. How effective is Nintendo for learning grammar?	1 2 3 4 5
2. How effective is Nintendo for learning vocabulary	1 2 3 4 5
3. How effective is Nintendo for learning pronunciation	1 2 3 4 5
4. How effective is Nintendo for learning reading?	1 2 3 4 5
5. How effective is Nintendo for learning listening?	1 2 3 4 5
6 How effective is Nintendo for learning speaking?	1 2 3 4 5
7. How effective is Nintendo for leaning writing?	1 2 3 4 5
8. My communicative capacity with others has improved	1 2 3 4 5
9. I feel more confident about using my English	1 2 3 4 5
10. Was the Nintendo DS an effective way to learn English in general terms?	1 2 3 4 5
11.- Open comments	