

Special Section “Mobile Learning Applications in Higher Education”

ARTICLE

Mobile learning: a collaborative experience using QR codes

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Abstract

The experience presented in this article highlights the educational potential of using mobile learning and QR codes in a secondary physical education classroom to foster healthy physical activity. The experience was designed as a collaborative didactic unit for 13/14 year-old compulsory secondary education pupils from two schools in Barcelona, Spain. The main objective was to simulate a Mount Everest ascent by performing collaborative resistance strength challenges designed by the pupils and converted into QR codes. The total number of strength exercise repetitions that the pupils from both schools managed to do collaboratively simulated the number of metres climbed towards the summit of Mount Everest. The experience was based on qualitative educational research and had a multiple case-study design. Moreover, it used a collaborative methodology to accomplish the challenge. The results obtained show the potential of mobile learning as an emergent educational tool that is capable of facilitating and fostering the teaching-learning process.

Keywords

mobile learning, physical education, secondary education

Mobile learning: una experiencia colaborativa mediante códigos QR

Resumen

La siguiente experiencia muestra las posibilidades educativas del uso del aprendizaje móvil y de códigos QR en el aula de Educación física de secundaria como herramienta para fomentar la práctica de actividad física saludable. La experiencia ha sido diseñada en forma de unidad didáctica colaborativa para el alumnado de segundo curso de educación secundaria obligatoria de dos centros educativos de Barcelona. El objetivo principal ha sido simular el ascenso al Everest mediante la realización de retos colaborativos de fuerza resistencia diseñados por el alumnado y convertidos en códigos QR. La suma de repeticiones de fuerza conseguidas de forma colaborativa entre el alumnado de ambos centros ha simulado en metros la ascensión al Everest. La experiencia se ha basado en la investigación educativa cualitativa y bajo un diseño de casos múltiple y ha utilizado una metodología colaborativa para la consecución del reto. Los resultados obtenidos han demostrado el potencial del aprendizaje móvil como herramienta educativa emergente facilitadora y motivadora del proceso de enseñanza aprendizaje.

Palabras clave

aprendizaje móvil, Educación física, enseñanza secundaria

1. Introduction

The technological, social and cultural changes brought about by the information and knowledge society have extended beyond the sphere of education, giving rise to a new ecology of learning (Coll, 2013). These changes are affecting every level of learning – the what, why, how, where, when and by whom of teaching and learning, thus making it necessary to re-examine how they should be incorporated into the school curriculum. In today's society, the impact of information and communication technologies (ICTs) has led to the emergence of new environments, educational

agents and learning opportunities. Consequently, ways of teaching and learning are shifting towards personalised learning and moving away from traditional universal schooling (Coll, 2013).

The advent of technology in education has provided teachers with new opportunities and resources to create new ways of teaching (Fundación de la Innovación Bankinter. Accenture, 2011). Thus, one of the major challenges that today's education faces is how to teach and educate in the context of a digital culture and society (Alonso et al., 2012).

1.1. Mobile learning

Mobile devices and applications (apps) are emergent technologies that will be incorporated into education in the near term (Informe Horizon, 2012).

"Mobile learning involves the use of mobile technology...", and one of the most important features is that it enables "... learning anytime and anywhere" (UNESCO, 2013). According to Cantillo et al. (2012), the technological features of mobile learning are portability, immediacy, connectivity, ubiquity and adaptability.

Regarding the teaching-learning process, the incorporation of mobile devices into education has considerable benefits and enormous potential. It enables collaboration among pupils, information searching, knowledge creation and improved interaction and communication among the various educational agents. In addition, it facilitates access to learning anytime and anywhere by enabling connectivity and the use of multiple apps for educational purposes (Fundación Telefónica, 2013)

In contrast to traditional learning, which is centred on the figure of the teacher as a beacon of standard knowledge, the use of technologies in the classroom fosters learning that is more active, dynamic and interactive (Fundación de la Innovación Bankinter. Accenture, 2011).

Regarding the teaching-learning process, Naismith et al. (2006) have asserted that the incorporation of mobile learning into education can produce considerable benefits. Mobile learning enables the construction of new knowledge from prior knowledge and the design of activities that promote learning situated in a real and meaningful context for pupils. In addition, it increases the potential for collaboration and social interaction among pupils, and generates informal learning and activities outside the scope of formal curricular learning, as today's learning can take place anytime and anywhere. Finally, the use of mobile devices can serve as a support for expanding and delivering resources and materials to pupils.

The experience presented in this article was undertaken at two compulsory secondary education schools in Barcelona, Spain, where compulsory secondary education is governed by the Spanish Organic Law on Education (LOE/2006) and Catalan Decree 143/2007. The current competency-based curriculum proposes a change of educational paradigm, as the goal is to ensure that pupils develop and acquire basic competencies. One of the core aspects of the current curriculum is the promotion of lifelong learning to provide the pupils with the knowledge and basic skills required to live in society and to spark their desire to carry on learning. The aim of the competency-based curriculum is to integrate various types of formal, informal and non-formal learning so that pupils are able to relate them to the content and use them effectively in different situations and contexts.

The current compulsory secondary education curriculum (LOE/2006) proposes the development

of eight basic competencies, one of which refers to information processing and digital competency (Guitert et al., 2008). To attain this competency, pupils should be able to search for, process and communicate information and turn it into knowledge, as well as use technology in a responsible, independent, reflective and critical manner. Within this context, the use of technology in the classroom fosters and supports the new teaching paradigm and helps pupils to learn by themselves (Prensky, 2008).

The current curricular approach to physical education in compulsory secondary education stresses the importance of acquiring and consolidating healthy lifestyle habits by doing physical activity and sport (González Arévalo, 2010). Looking after one's body and health, improving physical fitness and making an active, constructive use of spare time are competencies that physical education in compulsory secondary education must develop (Decree 143/2007). In addition, the competency-based curriculum must provide pupils with the skills, knowledge and expertise required to enable them to satisfactorily cope with the problems of daily life once they have completed their compulsory secondary education.

The experience presented in this article is about a practical application developed in a secondary physical education classroom. It combines the use of mobile learning and QR codes to foster and get the pupils engaged in healthy physical activity.

2. Research method

2.1. Methodological overview

The experience was based on qualitative educational research and had a multiple case-study design. It was implemented through a collaborative physical education project undertaken at two compulsory secondary education schools in Barcelona¹. The instrument used to evaluate the experience was a questionnaire.

2.2. Sample

The sample was formed by 128 13/14 year-old compulsory secondary education pupils from two schools in Barcelona.

2.3. Design of the experience

Learning objectives

The general objective of the didactic unit was to get the 13/14 year-old compulsory secondary education pupils from the two schools to simulate a healthy, collaborative Mount Everest ascent by performing resistance strength challenges that were shared and displayed as QR codes.

1. This experience was awarded first prize in the individual category of the 3rd ICT Best Practices competition organised by the Barcelona Education Consortium.

In accordance with the *Proyecto Atlántida* (Atlantis Project) (2008), which focuses on saving the democratic values of education and developing innovation experiences in the curriculum and organisation of schools (<http://www.proyectoatlantida.net>), the curricular assessment criteria – consisting of a statement and a short explanation of it – show the type and level of learning that pupils must achieve at a particular time with regard to the skills specified in the general objectives.

The starting point of the experience was the prescriptive assessment criterion for physical education applicable to 13/14 year-old compulsory secondary education pupils (Decree 143/2007): *To raise the individual level of physical fitness to improve health.*

Competencies

The experience placed emphasis on certain basic competencies. The interaction with the physical world competency was particularly important because the pupils learnt to work on strength to look after their health. In addition, the experience reinforced the learning to learn competency because the pupils were able to perform self-assessment and co-assessment throughout the process, as well as design their own challenges to work on strength. The citizenship and social competency was also developed through the collaborative work done to accomplish the challenge. Finally, the information processing and digital competency was developed using tools to construct QR codes, mobile apps to read them, music editing software and Google Forms.

The experience also developed specific physical education competencies. In particular, the competencies relating to the acquisition of healthy habits by doing physical exercise tasks to develop strength.

Content

The *Physical fitness and health* content block served as a tool to attain the learning objectives. To be precise, work was done on content relating to the development of strength as a healthy, basic physical quality, and on doing different exercises and using the tabata method to improve strength. The tabata method is currently used a lot in the spheres of fitness training and health, and involves exercising for 20 seconds and resting for 10 seconds in consecutive intervals for a total of 4 minutes. In addition, work was done on content relating to the use of different Web 2.0 tools and mobile apps, which are detailed further below.

Didactic strategies

The collaborative technique used to accomplish the challenge was a collective marker based on adding together the number of points achieved by every participant in a certain physical exercise task (Orlick, 1990, cited in Velázquez Callado, 2012). In this case, the collective marker that had to be reached was 8,850 metres, representing the summit of Mount Everest. An inclusive and participatory methodology was also used, as all the pupils collaborated to accomplish the challenge irrespective of their individual levels of performance or physical ability.

Planning and implementation

The experience was implemented as a didactic unit and was carried out in the third term of the academic year. It lasted for 12 hours and was divided into 12 face-to-face sessions for each school and year.

To accomplish the challenge, the pupils were organised into groups of four, and the ascent was simulated by adding together the number of individual and group strength exercise repetitions (reps) done in each session. Each group designed four strength exercises and converted them into QR codes, which it then exchanged with the pupils from both schools. To design the QR codes, the pupils used the QR Stuff and QR Voice tools, and to read them, they used various mobile apps.

In order to add together the number of strength exercise reps and earn ascent metres, the tabata method was used. In each session, the pupils did a maximum of two tabata series. In addition, to make the exercise as realistic as possible, the increasing difficulty of doing physical exercise at an altitude was simulated, so the reps achieved at each camp had a different value, as shown in the following figure:

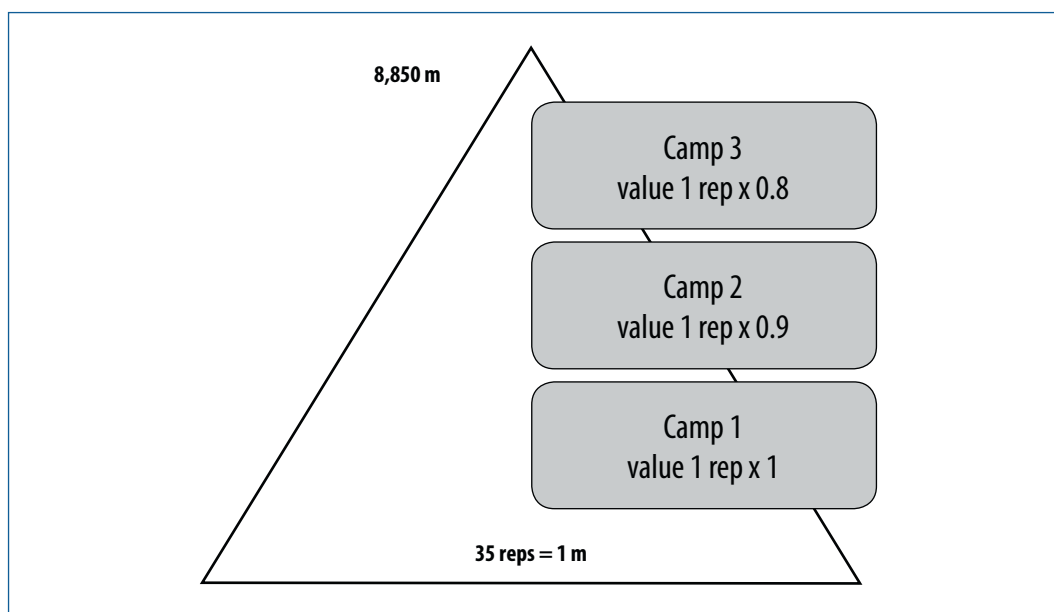


Figure 1. Rep, value and ascent metre details.

For example, a group achieving 350 strength exercise reps at Camp 1 effectively managed to climb 10 metres.

For the Camp 1 and Camp 2 ascents, two sessions were used, respectively. For the Camp 3 and Camp 4 ascents, three sessions were required because the value of the reps was lower owing to the hypothetical influence of altitude.

Assessment

The assessment criteria and their relationship to the learning objectives were as follows:

- Designing 4 healthy, collaborative resistance strength challenges in groups of 4. (Objective 1) 20%.
- Putting effort into accomplishing all the healthy, collaborative resistance strength challenges. (Objective 2) 20%.
- Designing 4 healthy, collaborative resistance strength challenges in QR format for pupils from another school. (Objectives 3 and 4) 30%.
- Performing the final evaluation of the unit by submitting the Google Forms form. (Objective 5) 10%.
- Using different Web 2.0 tools to develop the unit. (Objective 5) 5%.
- Entering the record of reps achieved on the form. (Objective 5) 5%.
- Simulating a Mount Everest ascent by performing healthy, collaborative resistance strength challenges converted into QR codes. (General objective) 10%.

Assessment procedures

A competency-based curriculum places the pupils at the centre of the teaching-learning process; they become the true protagonists, whereas the teachers take on the roles of process facilitators and guides. Within this context, assessment takes on a new meaning. Far from being penalising or qualifying, it becomes processual, regulatory, instructional and formative (Sanmartí, 2010). In this experience, both the teachers and the pupils took part in the process using three types of assessment: hetero-assessment performed by the teachers, co-assessment among the pupils and self-assessment by the pupils.

In addition, the experience took into account the three assessment stages and used initial or diagnostic assessment, formative or continuing assessment and final or summative assessment.

Several assessment instruments were used in the course of the experience. These provided the teachers and pupils with information and allowed the learning process to be monitored and regulated. The instruments used were checklists, questionnaires (online forms) and rubrics.

Web 2.0 tools

The virtual learning environment that served as a meeting point for both schools and facilitated the experience follow-up was a Google Sites website called *Junts/es fins l'Everest* (Together to the top of Mount Everest). It was organised into different pages as follows: presentation, challenge, competencies and indicators, learning objectives, content, assessment, Web 2.0 tools, QR designs, musical tabatas, challenge monitoring and a marker that, like a countdown timer, indicated the number of days left to accomplish the challenge.



Figure 2. Experience website (Google Sites)

The following table shows the Web 2.0 tools used in the experience:

Table 1. Web 2.0 tools used in the experience.

Web 2.0 tools	
Voki	Voki was used to present the challenge to the pupils.
Tools for designing QR codes	QR Stuff http://www.qrstuff.com/ QR Voice http://qrvoice.net/
Mobile apps for reading QR codes	QR Droid for Android, QR Reader or Crafter for iPhone, BIDI: Lector de Códigos QR for Blackberry, QR Code Reader for Windows 7.
Audacity	The pupils used Audacity to design their own musical tabatas for strength work.
Google Forms	Two Google Forms forms were used: one for daily monitoring of reps done by each group and school to note the metres achieved in each session, and another for gathering the pupils' final evaluations of the experience.

To monitor the challenge, an Excel spreadsheet was designed and shared on Google Drive. It was also embedded in the Google Sites website so that the results obtained by each group and school in each session could be displayed.

The following figure shows the curricular elements of the didactic unit:

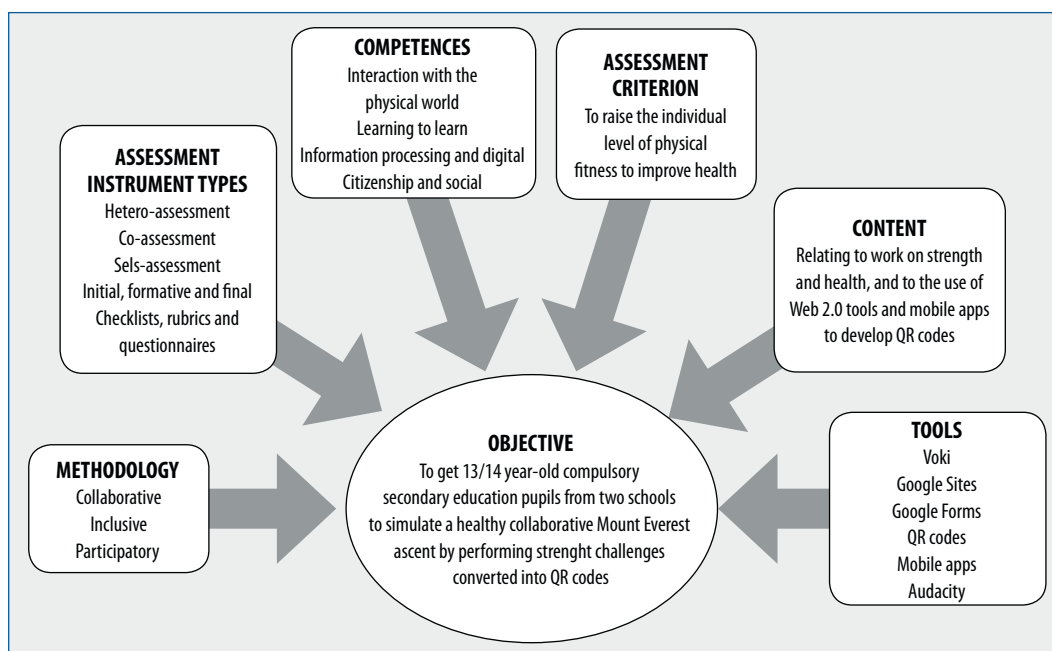


Figure 3. Curricular elements of the didactic unit.

3. Results

The learning results obtained from the ICT-mediated experience were satisfactory. Particularly noteworthy were how much the pupils liked using the collaborative methodologies, the usefulness of mobile phones as motivational tools that create and foster learning circumstances, and the transfer of learning connected with health and technological apps to the pupils' real lives.

The results were organised into the following categories:

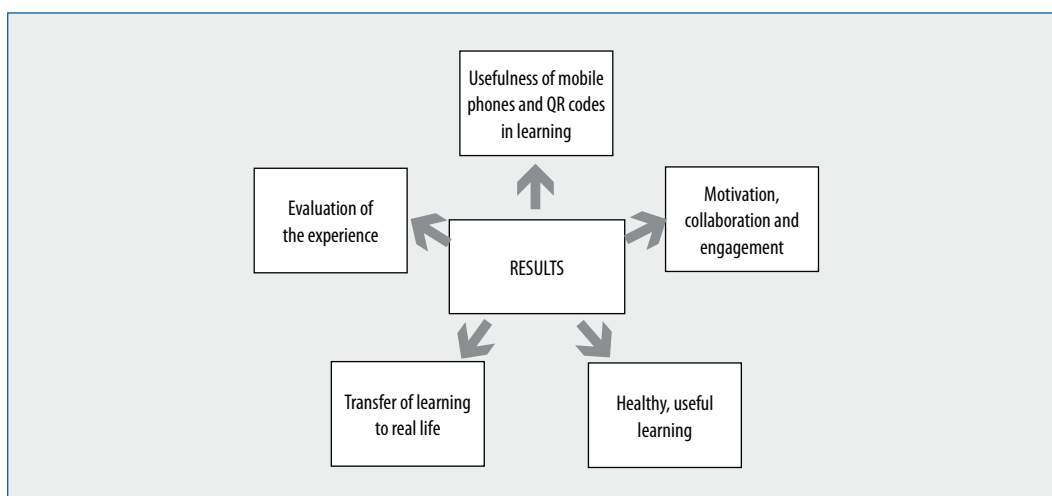


Figure 4. Results categories.

Usefulness of mobile phones and QR codes in learning

Sixty-six percent of the pupils positively rated the usefulness of mobile phones in the classroom because they had enabled them to do some activities, to learn new and useful things, to use mobile apps that they had been unaware of, and to combine and learn technological and physical activity concepts.

The pupils satisfactorily rated the use and design of QR codes in the desired format (voice, video and text) to learn new and healthy strength exercises and to exchange them with pupils from another school. In addition, they pointed out that discovering what strength challenge was hidden behind each QR code had sparked their interest and motivation.

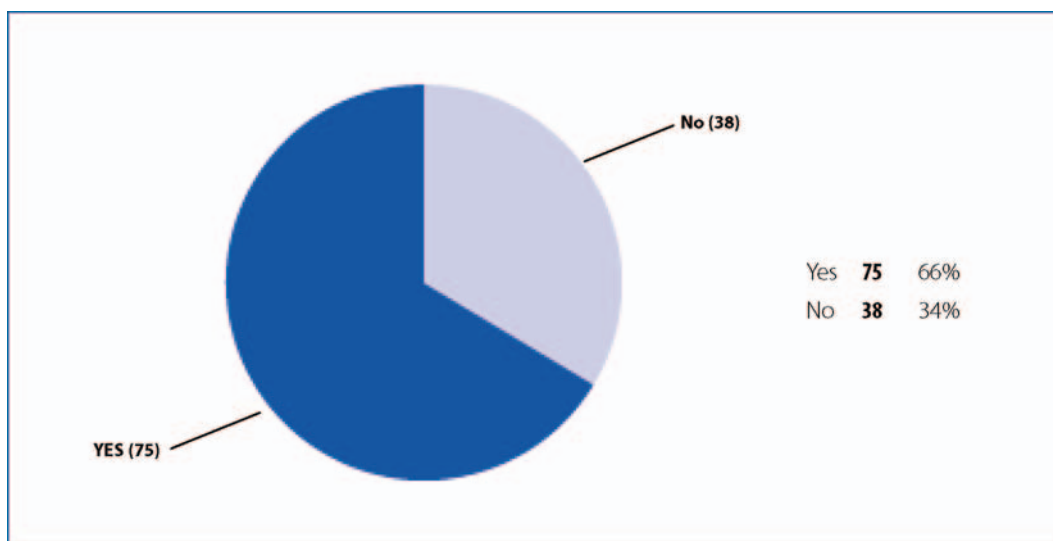


Chart 1. Evaluation of mobile phone use in the physical education classroom.

Eighty-seven percent of the pupils said that they had not previously used any tools to design QR codes, and that learning about them had been very positive and relevant. One pupil said²: *"I think that QR codes will be very useful in the future, and we need to know how to use them."*

The pupils rated mobile phone use in the classroom with comments like: *"this is the first time we've been asked to bring our mobiles into the classroom"*, *"it's much easier to do the lesson with a mobile"*, *"it was different from other classes"*, *"it was fun"*, *"I'd rather use new ways of learning than pens and notepads"*, *"I liked it because I didn't know how to design QRs"* and *"I liked it because I'd never have thought that they'd make us use a mobile in a lesson, especially not in PE lesson."*

Healthy, useful learning

The pupils positively rated the fact that they had worked on the strength of different muscle groups by doing new exercises and using various materials. Ninety-eight percent of the pupils said that they had learnt to do resistance strength exercises in a healthy way, and commented: *"this unit was really*

2. Translator's note: All the comments made by the pupils have been translated from Spanish into English.

useful because I've learnt to do physical activity and look after my body, and that's important because we'll only have one body in this life."

Motivation, collaboration and engagement

The pupils positively rated the collaborative work done and the chance to interact with pupils from another school by exchanging QR codes. The pupils pointed out the high levels of participation and engagement in the challenge because everyone, through their strength exercise contributions, had helped to accomplish the challenge irrespective of their individual levels of fitness and/or physical ability. The pupils said: *"we all did the activities, and even though you weren't putting in that many reps, you felt that they were important"; "this unit has been a new experience as we've never worked with other schools before."*

In addition, 89% of the pupils considered that working with their own music increased their motivation.

Transfer of learning to real life

Eighty-one percent of the pupils satisfactorily rated the usefulness and the transfer of learning acquired to their real lives: health, body care, mobile app use and QR code design.

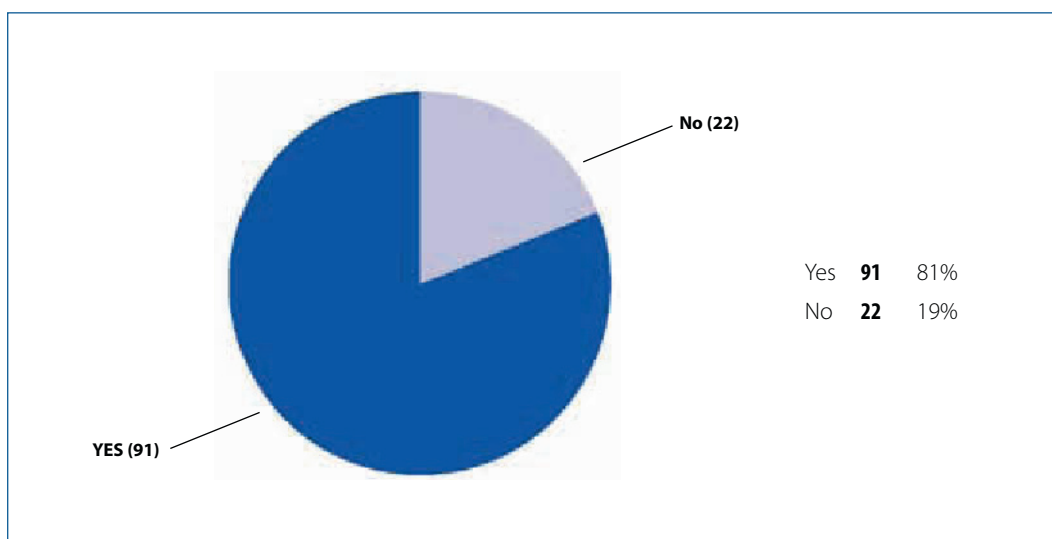


Chart 2. Usefulness of learning acquired to real life.

The pupils said: *"it'll be very useful to me, in a job where QR codes need to be used", "for health", "when I want to do sport" and "to know how to look after my body."*

The pupils' evaluations of the experience

The pupils positively rated the experience, particularly because it had given them the opportunity to work jointly with another school to accomplish a common challenge, to learn to do healthy strength

exercises, to design QR codes and to use mobile apps that they had been unaware of at the start of the experience. In addition, they said that they had had fun, had made an effort and had worked in teams to accomplish the challenge.

Eighty-nine percent of the pupils rated the unit with a score between 7 and 10, while 12% of the pupils rated it with a score of 6 or lower.

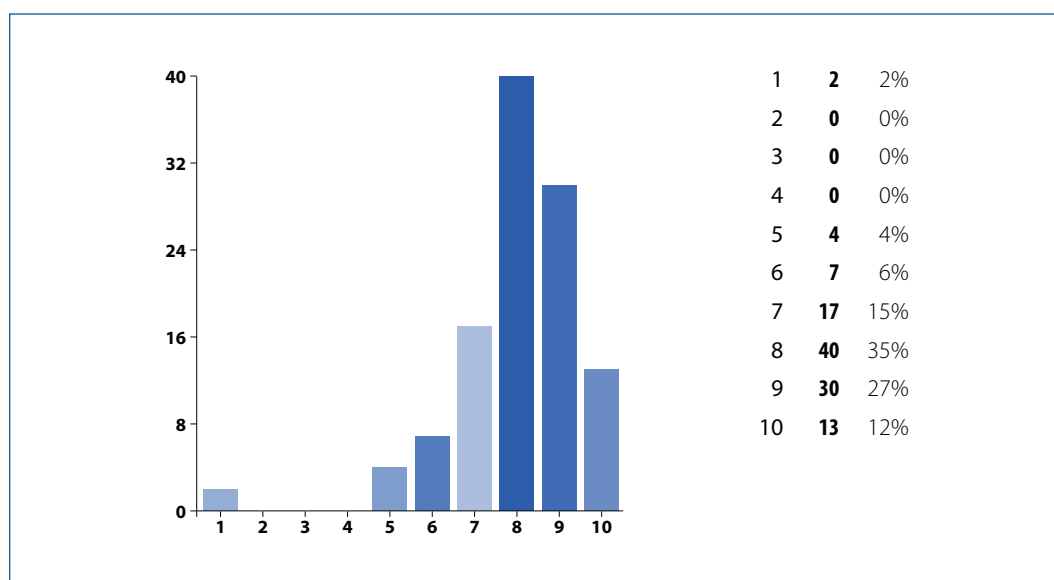


Chart 3. The pupils' evaluations of the unit

Ninety-four percent of the pupils rated the teachers' actions with a score between 7 and 10, while 8% of the pupils rated them with a score of 6 or lower.

Finally, continuing on from the sentence *"This unit was like a/an... because..."*, the pupils rated the experience with comments like: *"its was very interesting because we mixed cooperation, technology and music in the classroom"*, *"it was a surprise because we did it with another school"*, *"it was like an explosion of creativity because I learnt loads of new things"*, *"this unit was a new experience in technology and PE, it was my favourite unit of the year"*, *"this unit was a new activity because we did activities that we hadn't done before in other subjects (QR)."*

Evaluation of the learning results

The results obtained in the pupils' learning were very satisfactory. The pupils learnt to use different technological tools while self-managing the development of strength in a healthy way using a collaborative working methodology. The pupils demonstrated high levels of motivation and engagement in the various activities and in the accomplishment of the challenge. In fact, 94% of the pupils passed the didactic unit.

4. Conclusions

"In the 21st century almost all work will be done in groups, most often facilitated by technology."

(Marc Prensky (2011). *Teaching Digital Natives*, p. 68)

The results obtained from the experience open up a broad range of opportunities for incorporating mobile learning into the physical education classroom as an educational tool and an emergent, potential methodology, thus coinciding with the results of the study conducted by Ibáñez and Asensio (2012) in the secondary education sphere.

The experience presented in this article is framed within the current concept that Adell and Castañeda (2012) term 'emergent pedagogy'. Educational practices based on this pedagogy have certain features that were taken as points of reference for this experience. For example, the didactic unit was implemented as an open collaborative project that encouraged several teachers and schools to participate; it strengthened skills and attitudes towards learning to learn and an engagement in learning beyond the classroom; it surpassed physical and organisational boundaries by uniting formal and informal contexts, thus shaping new ecologies of learning (Sangrà, 2012).

Coinciding with the results of the study conducted by Ibáñez and Asensio (2012), this experience has shown how important mobile phone use is as a positive and motivational tool to improve the learning circumstances of pupils studying physical education. In addition, the pupils rated mobile phone use in the physical education classroom as a fun, enjoyable experience, coinciding once again with the study by Ibáñez and Asensio (2012).

According to Cantillo et al. (2012), the incorporation of mobile phones into the classroom has enabled a number of benefits to be gained in relation to the development of certain basic competencies, skills and abilities among pupils. For example, in the experience presented here, active participation skills were developed through the exchange of challenges converted into QR codes with classmates or with pupils from another school, through the proper, responsible use of mobile phones in the classroom, through learning about concepts and technological tools that could be transferred to other curricular subjects or real-life situations, and through the design of basic musical sequences to self-manage their own strength training for health. It was therefore found that mobile learning combined with the use of collaborative, inclusive strategies enabled the pupils to improve their physical fitness in a fun, healthy way.

According to Naismith et al. (2006), the incorporation of mobile learning and technology into educational processes fosters collaboration and social interaction, and both of these were observed in the experience through the exchange of QR codes with pupils from different schools.

Various studies have highlighted the benefits of mobile learning for teaching, learning and educational change. Given the accessibility and enormous potential of mobile devices, they enable learning to be taken outside the classroom and pupils to create and share their knowledge (Fundación Telefónica, 2013). To sum up, the experience has enabled a reflection on the benefits of using mobile learning as an educational tool and an emergent methodology in the physical education classroom, as well as an observation of its enormous potential for learning and for fostering a healthy lifestyle among young people in a fun, collaborative, contemporary and technology-mediated way.

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