The Portuguese Maritime Voyages of Discovery: the exploration of the history of a city with an App as an educational resource

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Abstract

In this paper we present an evaluation of an App for mobile devices, 'Roteiro dos Descobrimentos', as an educational digital resource for primary school students. The study involved the participation of 131 students and eight teachers. Data were collected from participant observation, students' questionnaires and interviews to students and teachers. According to students, they learned new things, related with the topics explored, in an easy and funny way. Students also emphasized as positive aspects the fact that they had to face different challenges and the need to mobilize their knowledge to solve them. Teachers referred that students showed great interest and enthusiasm during the activities. As main gains, teachers stressed that the application fosters the relationship of students with the city, facilitates collaboration, and promotes students' autonomy. In resume, it seems that the playful and interactive dimension of the App promoted the development of important skills such as the ability to interact with the environment, collaborative work, autonomy, and reading and interpretation skills. As a conclusion, there is a great receptivity to integrate mobile technologies in the teaching and learning process, but the role of the teacher can't be dismissed, as a mediator and educator.

Keywords

Digital educational resources; Mobile learning; Mobile applications; Primary education.

I. Introduction

> The voyages of discovery, as revolutionary leaps in
> the technology of communication, reduced the
> distance between the world's societies...
>
> (Hess, 1970, p. 1892).

In nowadays society, in which technological and scientific knowledge assumes a leading role, it is important to form enlightened citizens, who are able to reflect critically about the world and to make both responsible and informed decisions concerning issues related to their lives (Holbrook & Rannikmae, 2007; Osborne & Dillon, 2008). The skills needed for a citizen of the 21st century are based on critical thinking and problem solving, on effective communication, collaboration, creativity and innovation (AMA, 2010; EP&C, 2006).

How can school education contribute to achieve this goal? There has been a recent trend towards competence-based teaching and learning with very significant changes in school curricula. These changes involve more engaging cross-curriculum approaches emphasizing the development of different kinds of literacy, as well as an increased use of "real-life" applications, providing appealing learning contexts, meaningful and related with students' social reality (Bybee, 2000, 2001). In order to achieve high levels of literacy, international recommendations (Osborne and Dillon 2008) point out the need for teachers to develop a critical teaching strategy, organize challenging learning environments, both in formal as well as non-formal settings, and give careful guidance to students towards self-regulated and challenging learning.

The increasing demand in these skills has been especially apparent at elementary grades. Indeed, one of the fundamental objectives of education, in general, in elementary schools is to enable students to observe their natural environment and to develop skills required to understand and explain both themselves and their environment (Akinoglou, 2008). This approach, when focussed on elementary education, can highlight opportunities for building onto children's innate curiosity about their natural environment and the world around them, since it implies research around a real-world familiar problem (Boorman and Rogers, 2000; Martins and Veiga, 2001). These everyday experiences could act as meaningful contexts that are fundamental in stimulating children's curiosity and involvement in the learning process (Boorman and Rogers, 2000; Milne, 2010; Murcia, 2007).

Mobile technologies are now an integral part of contemporary societies. This new reality reinforces the need, as advocated in numerous international reports (AMA, 2010), to rethink the concept of school and how to understand the process of teaching. It is important to equally value the practices and learning that occur in different contexts, in and out of school, and to challenge the different educational agents to broaden their horizons with regard to the artefacts possible to use, in order to minimize the learning difficulties that are increasingly called upon to deal. In fact, the new generations grow up in a technological environment, being commonly known as "digital natives" (Prensky, 2001). This concept implies that not only they dominate the digital language of communication technologies, but also that they are dependent on them to access information and to interact with others. The expectations of these students from education go beyond learning technology, moving more into the realm of how to make use of technology as a tool in the learning environment.

The expansion and spread of mobile technologies has led to a growing need to understand their educational potential, as communication devices. These technologies are mobilized every day for storage and information search and for the construction of knowledge, so that we can analyze the feasibility of the creation of new educational settings, open to innovation, to interaction and to collaborative work. According to Baran (2014), significant investments have been made to provide infrastructure, content, and resources related to the integration of mobile devices into learning environments, and there has been a growing interest in this evolving landscape (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sánchez and Vavoula, 2009).

Nowadays, some authors have been claimed for the existence of a new educational approach, called *mobile learning* (*m-learning*) (Furió, Juan, Seguí and Vivó, 2015). Mobile learning has been defined as any sort of learning that happens when the learner is not on a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies (Schwabe, Göth and Frohberg, 2005). Independently of its definition, this concept emphasizes mobility (Kukulska-Hulme et al., 2009), access (Parsons and Ryu, 2006), immediacy (Kynäslahti, 2003), situativity (Cheon, Lee, Crooks and Song, 2012), ubiquity (Kukulska-Hulme et al., 2009), convenience (Kynäslahti, 2003), and contextuality (Kearney, Schuck, Burden and Aubusson, 2012). This approach has the potential to make the educational process more flexible for students and can meet the needs of teachers, since mobile technologies are used anytime and anywhere.

According to Mouza (2015), research into the educational uses and student outcomes of this type of educational approach is still in the beginning. There are, however, some studies that have already showed the benefits of this approach to students, particularly increasing motivation, creativity and students' performance (Melero Hernández-Leo and Manatunga, 2015), on the ability to develop skills such as decision making, cooperation, strategy and problem solving (Furió, González-Gancedo, Juan, Seguí and Rando, 2013), on the promotion of an increased autonomy and curiosity outside the classroom environment (Ciampa, 2013) and also on the promotion of an 'healthy' competition among students (Cagiltay, Ozcelik and Ozcelik, 2015). According to Boticki, Baksa, Seow and Looi (2015), mobile technologies not only encourage students to take control of their own learning, allowing them to set their own learning goals, but also encourage communication among students and with the teacher, stimulating group work and rich discussions of ideas.

However, and according to several authors (Cochrane, 2012) some limitations still exist, such as lack of theoretical and pedagogical underpinnings, sustainable integration into formal educational contexts, and, particularly, lack of teacher support and training. Besides, teachers' adoption of mobile technologies has been challenged given their lack of preparation to take advantages or make informed decisions about these technologies (Kukulska-Hulme et al., 2009).

In this paper we present an evaluation of an App for mobile devices, 'Roteiro dos Descobrimentos', as an educational digital resource for primary school students, that centers on the exploration of a familiar historical and cultural context.

II. Methodology

a. Context of the study

This study was developed within the research project 'Roteiro dos Descobrimentos' (PT02_2ºRPS_0017), which had as main objectives to promote a closer relation between people, and children in particular, with the city of Lisbon, to promote culture in its various dimensions,

scientific, historical, environmental, technological, and to qualify and diversify the educational offer for the valorization of the historical and natural heritage.

b. Application design: description of the itineraries

The App 'Roteiro dos Descobrimentos' was developed as a computer application that can be downloaded on any mobile technology for devices with Android operating system, and is aimed to young children to use in school context or a family context. The existing contents fall into the themes of the curriculum (years 3 to 6) of the 1st and 2nd cycle of basic education.

The application incorporates a set of itineraries throughout the city of Lisbon including old districts, historical monuments and sites, and different museums. These itineraries are organized in four different dimensions, addressing historical aspects associated with the period of the discoveries, topics related to cultural diversity, issues related to maritime navigation, and aspects related to the marine biodiversity of the different oceans.

While physically (not virtually) walking throughout these itineraries the application draws the user's attention to certain details. The challenges proposed are learner-centered, promoting direct in-situ observations and collaborative work. Moreover, in all of them, the teacher is sometimes called to participate, having to certify the picture taken by the student. In figure 1 there are some examples of the tasks.
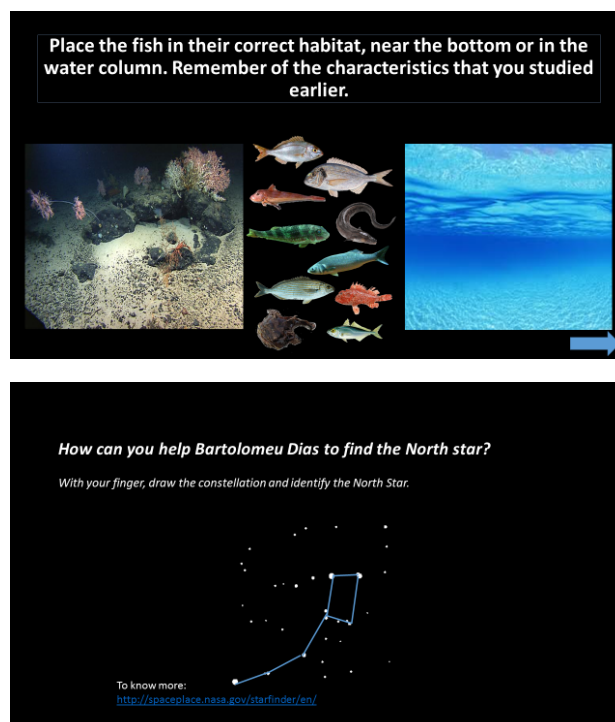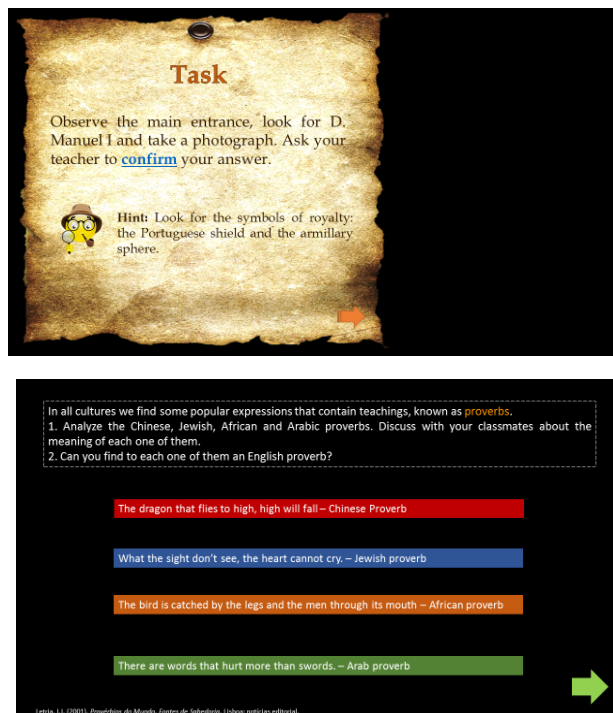
Figure. 1. Examples of the tasks of the App 'Roteiro dos Descobrimentos'.

Source: http://www.ie.ulisboa.pt/didatica-das-ciencias/app-roteiro-dos-descobrimentos

Finally, in order to promote students' autonomy, all the itineraries offer direct access to historical and scientific information, including historical accounts and real stories, which allow the contextualization of each itinerary. In figure 2 there are some examples of the information presented.
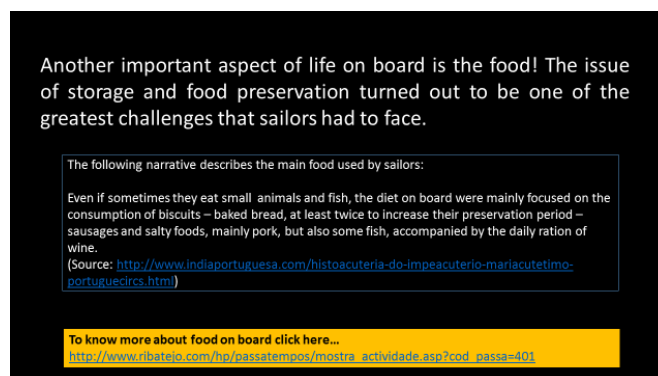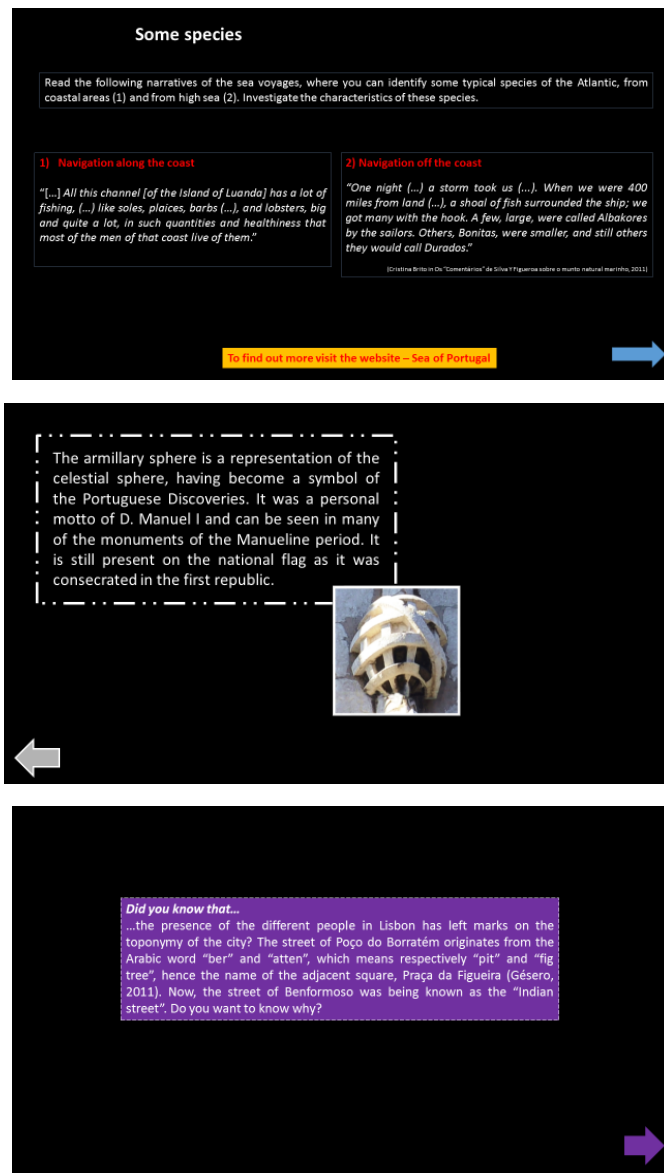
Figure. 2. Examples of the scientific and historical information presented in the App.

Source: http://www.ie.ulisboa.pt/didatica-das-ciencias/app-roteiro-dos-descobrimentos

c. Participants

This evaluation study involved the participation of 131 students, between 8 and 11 years old, from five different basic schools. Students were from seven different classes: three classes of the 4th level (from two different schools), and four classes of the 5th level (from three schools). All schools were situated in the city of Lisbon. For each class, the teacher responsible for the visit was interviewed and in one case there were two teachers involved. So, there were a total of eight teachers involved in the study: three teachers with a more generalist background, four teachers of Natural Sciences and one teacher of Portuguese Language. Each teacher chose the itinerary to follow with their students.

The itineraries were tested during one month (April 2016) and for the accomplishment of each itinerary, students were asked to work in groups (with a composition ranging from two to eight

students, depending on the number of mobile phones available). Most of the students worked in pairs. Each class complete only one itinerary.

For these students the use of mobile devices at school or study visits was not a common practice, but most showed great familiarity with these technologies, what facilitated the use of the App.

d. Data collection and analysis

The main objectives of this study were to evaluate the involvement of students and teachers in the itineraries, both in terms of students' learning as on their attitudes toward technology, and to understand the teacher's view about the importance of the use of technology in the teaching and learning process.

All visits were accompanied by a researcher of the team and by the teacher of the class. Data collection was carried out in two steps. At the end of each itinerary, all students were asked to complete an opinion survey (a closed questionnaire, with yes or no answers), focused on the evaluation of the itinerary performed, in which students need to say if they agree or not with a set of statements, taking into account the potentialities and difficulties related with the use of the mobile phone, the aspects they liked most in the itinerary, the aspects that facilitated their learning, and the learning achieved. The questionnaire data were submitted to a descriptive statistical analysis. This instrument was essential to understand the aspects that worked better and worse in each itinerary, allowing its further improvement.

All participant teachers, individually, and some of the students, in groups of five to six (randomly selected) of each class, were also interviewed (semi-structured interviews). A total of 33 students were interviewed. The interviews were used to deepen our understanding about the perspectives of both participants in the following dimensions: application evaluation, the impact of the App in students' learning and aspects related with the use of technology in teaching and learning. All interviews were audio-recorded, transcribed and subjected to content analysis, based on categories of analysis that emerged from the responses given by the participants (inductive analysis) (Milles and Huberman 1994).

Both data collection instruments, questionnaires and interviews, were previously analyzed by different researchers in order to assure its adequacy to the objectives of the research.

III. Results

a. Students' perspective

General appreciation of the App

The majority of students liked the application and the itineraries (N = 127, 96.1%), considering it easy to use (N = 124, 94.4%). According to the analysis of the questionnaires, students' have learned new things with this application (N = 125, 94.4%) and considered that was fun to learn about the topics in focus (N = 123, 88.6%) and that it was an easier way to understand certain subjects (N = 123, 80.5%). In the interviews they emphasized the different challenges they had to face and the need to mobilize some knowledge to solve them. According to their own words:

> 'The things I liked most were taking pictures, learn more things about the topics that were there, and also enjoyed the interactive games.' (4th level)

Moreover, all students interviewed (N = 33) claimed to have enjoyed the application, and most would use it again, even with their families (N = 29, 87.9%).

> 'Yes, because I also wanted to see the other places, the other itineraries and also I will enjoy to go with my family just for them to explore more places and have more knowledge.' (5th level)

However, four students said they would not use the application again. The aspects mentioned by these students include infrequent use of mobile phones (N = 1) and the fact that they preferred the explanations of the museum guide (these students performed an itinerary in a museum).

> 'We learn more with the guide, because she was explaining more interesting things, and the APP always explained the same thing.' (5th level)

Regarding the amount of information presented in the App, most students said that it is sufficient (N = 19, 65.5%). However, nine students (31.0%) considered that the App (the itineraries) could have more information, including more text, games and / or images.

Positive and negative aspects of the App

The aspects that students liked most were to work in groups (92.9%), to learn new knowledge (92.8%), the contents that were easy to understand (92.0%) and to share results with their colleagues (90.6%).

> 'It was cool to try to answer the questions in group and try to do a summary of the answer all together. Each of us gave an opinion and we reached a joint conclusion.' (5th year)

> '… It was fun to be touching on the mobile phone, and good because it teaches us things. I did not know some things that were there. But as I was in group I understood it.' (4th level)

However, six students said that despite they enjoy working in a group, in the given situation the group did not work at all. According to our direct observations, this situation (not functional group) was more evident in the larger groups, because of the difficulty to all see and access to the same mobile phone.

The aspects that students liked less, besides some graphical aspects of the App (76.4%), where (i) the low complexity of the tasks, because of the few options given in some challenges, which facilitated the selection of the correct answer, and (ii) the possibility of taking pictures to non-relevant objects, instead of being automatically constrained to take pictures only to the correct objects.

Moreover, students felt that the scientific content involved (40.0%), the vocabulary used in texts (35.5%), the information analysis (35.2%) and to have to focus on what was most important to learn (34.7 %) were the most difficult aspects of the application. Although the difficulties felt, they said they were capable of performing all the tasks.

> 'I managed to overcome my difficulties very easily. It had to do with the pictures. For example, there was a fish on the screen that had a black point in the tail that was difficult to found. And there were many pieces of a fish that we must put together and I had difficulty in understanding the different parts. But I managed to work things out for myself.' (5th level)

The App as a learning resource

When asked about the novelty of using a mobile phone for learning, the answers focused mainly on the idea that learning became more fun and that it was a new way of using the mobile phone besides playing.

> 'We had fun and at the same time we learnt and we still had to find out things. We had to find the way to learn.' (4th level)

> 'It was a good experience, because with this App we don't need to have a lesson about the subject, and we learnt things that you were trying to understand, and learnt in a funnier way, it gives us more desire to learn.' (5th level)

However there were some divergent opinions regarding the facility of learning with the mobile phone. Eleven students (37.9%) said that they learn more easily with the mobile phone than with the teacher / guide and eleven students (37.9%) did not consider it easier with the phone than with a teacher / guide, or the textbook. Five students (17.2%) stated that the mobile phone can be seen simultaneously as something good, because it allows access to more information, and something not so good, because teachers understand better the doubts of the students.

Example of positive opinion:

> 'It has not the same interest. Instead of being a person talking, in which we started to get tired of hearing the same thing, it is different because with mobile phones we like to touch, and so we get more and more excited, and we want to proceed.' (5th level)

Example of less positive opinion:

> 'Because the App does not say all. People say more things. The Apps do not speak with us.' (5th level)

Acquisition of scientific knowledge

The analysis of the questionnaires revealed that students, taking into account the itinerary performed, reached a better understanding about the different aspects explored, like the orientation processes used to navigate (100%), the function of the navigation instruments used at that time (94.7%), the diversity of marine organisms (91.5%), the different oceans (91.3%). Interviews, in addition to these themes, also highlighted learning related to the historical aspects of that period.

Concerning the aspects that facilitated learning, students stressed the ease of understanding the contents (88.5%), the direct in-situ observations (87.6%), group work (86.2%) and the mobilization of previous knowledge (85.2%).

> 'The way the App was written was quite simple and it was easy to understand. If there was a guide to explain everything I would have ended up getting tired.' (5th level)

> 'It's captivating and cool because we have to go to look for the sites, taking pictures of what we are learning and use our expertise.' (5th level)

This application also aroused their interest to learn more about the topics explored (N=123, 8.3%):

'…I would like to learn more about the itineraries followed by the navigators and what they do when reaching those countries.' (4th level)

'I would like to have seen more in each monument, to further explore it, to see other historical figures, and also to have more questions during the itinerary because I liked to performed it.' (5th level)

b. Teachers' perspective

General appreciation of the App

In general, all teachers involved (N=8) liked the App and will use it again, '*I would not only use it again; I have, in fact, already used it in school in the study of the history of Portugal*'. However, some of them pointed out that there should be a prior preparation of students to using it, to avoid the risk of losing the richness of the places they are visiting because of being only focused on the use of the mobile phone.

In the interviews, teachers stressed that the proposed application is suitable or appropriate to each performed itinerary (from 1 to 4: two teachers classified it with a 3, and five teachers with a 4), age group (from 1 to 4: four teachers gave a 3 and four gave a 4) and to the involved contents (from 1 to 4: seven teachers gave a 3 and one teacher gave a 4).

The App as a learning resource

Teachers referred that students showed great interest and enthusiasm for the App, and have remained motivated to use it until the end of the itineraries. As main gains, teachers stressed that the application fosters the relationship of students with the city of Lisbon, facilitates collaboration among them, and the interactive games promote 'learning by doing' and student motivation for learning.

'It takes students to discover their city. We explored the App in the classroom and I found that many of them were unaware of the place where they live.'

'The collaboration between the participants and the deepening of the concept of "gamification".'

With regard to the connection with the curriculum, in general, teachers consider that in these school levels it is always possible to make connections, and articulate different subjects, namely Natural Sciences, Geography, History, and Portuguese.

Regarding the use of challenges as an asset in the learning process, teachers have different opinions (in this case, only seven teachers answered). Three of them considered it relevant (37.5%), three felt that it is moderately important (37.5%) and one think that is low (12.5%). However, according to all of them, this App brought some innovation to the study visits, in particular in the way students observe and interact with the places they are visiting, in the interaction with the teacher and the colleagues themselves, and in the autonomy that students acquire.

'... The interest of kids is redoubled, they are always willing to continue in their learning, and how they are in a group of two, they can talk to each other about the questions they have. On the other hand, the fact that they must ask the teacher to see if the picture is right or wrong. Therefore, the teacher is not completely out, although

for me it could be. There is a strong interaction and that's good because they could be quite autonomous.'

Students' learning

According to the interviewed teachers, this App, in addition to the promotion of knowledge acquisition about the different subjects explored (biology, technology, history, citizenship...), promotes the development of a diverse set of skills such as digital literacy, observation, understanding and interpretation of data, analysis of new knowledge and concepts, cooperation between peers, and autonomy.

'First, the digital and technological literacy; secondly, the opportunity to look, observe and make more meaningful learning that results from the study visits or other situations.'

'Reading/interpretation skills and search/select knowledge about monuments. In addition to the training of attention and memory.'

One aspect also mentioned was the promotion of competences of citizenship, '*The notion of globalization and interculturality*', essential to live in our modern societies. Indeed, at least one of the itineraries is focused in topics related to cultural diversity, addressing aspects related with the languages and costumes of the different communities present in the city. The exploration of these different cultures could promote a greater tolerance to lead with what is different and strange and to respect the other.

App use in an educational context

With regard to the use of Mobile technology in the teaching and learning process, teachers say they are important and necessary but that they should not be exclusive, since it is also essential the intervention of the teacher and the traditional teaching methods.

'It is therefore necessary to have a new look at these technological artifacts, given the pedagogical added value that they potentially have, to the extent that if mobile devices are used as instructional tools to build learning, they can be treated as tools to help students perform their tasks and promote their development'

'They are very important and they are increasingly used in the education system because students use it at their own; however, it is necessary to define rules for using it for a meaningful utilization'

In this last quote, it is visible also the concern that some teachers have regarding the danger of students concentrate more on the device that on the content, or that the limitation of the technological format restrictions could confine the learning strategies that could be implemented when using these devices. This latter aspect is related with the suggestion given by one of the teachers, that the App should constraint more the activity of students during its use:

'(...) they shouldn't be able to move on in case of incorrect answers; photographs at random should be locked; (...); impossibility to proceed the tasks without direct observation of what is being asked; the puzzle pieces should only be won when the answers are correct'

According to this teacher, the fact that the App itself constrained and limited the development of the itinerary, in case of incorrect answers will compel students to invest more in its completion and will prevent its usage in an unreflective way (like a game).

IV. Discussion

The results of this study suggest that the itineraries developed in the App 'Roteiro dos Descobrimentos' promoted learning of specific scientific concepts, taking into account the subjects explored, as well as a greater connection of students to the city of Lisbon. According to all participants (teachers and students), it was a successful App, since it was easy to use, and allowed learning of diverse contents in an easy and funny way.

Moreover, according to teachers' opinion, the use of the App promoted the development of several important skills, including the ability to observe and interact with the environment, cooperative and collaborative work, autonomy, skills of reading and interpretation of texts and images, and skills to research and understand the information obtained. This evidence is consistent with the existing literature on this subject in the sense that the use of mobile technologies promotes the development of various skills and positively influence student learning (Furió et al., 2013; Ciampa, 2013; Cagiltay et al., 2015).

Finally, learning seemed to be greatly facilitated by the group work and in-situ observations, two main characteristics of the proposed tasks. These data are consistent with the work of Cahill, Kuhn, Schmoll, Lo, McNally and Quintana (2011), in which it is argued that the use of mobile phones on field trips promotes the sharing of information between colleagues, the discussion of ideas, greater involvement with the surrounding environment, including with teachers and students, and a more active participation in the development of the activities.

Concerning the integration of mobile technologies in the teaching and learning process, the analysis of the perspectives of the teachers involved showed a great receptivity to its use and even its urgency, due to the benefits that this entails. However, they stressed the need to constraint more the tasks present in the App itself, to compel students, during its use, to invest more in its completion and prevent its usage in an unreflective way. But, the problem implicit to this suggestion is the consequent restriction of students' autonomy and decision-making ability.

This tendency of teachers to integrate technology in order to provide more content in a digital way, instead of using them to enhance learner-centered approaches was already stressed by Karsenti and Fievez (2013). Probably, if the itinerary was previously explored in classroom with students, promoting their understanding about the objectives and characteristics of the itinerary to be followed, they will be more focused on their own learning. Indeed, many studies (Furió et al., 2013; Ciampa, 2013; Cagiltay et al., 2015) already stressed the need for a prior preparation to the visit, and for the definition of some rules regarding the use of mobile phones, as there could be a tendency for students to disperse their attention to something irrelevant.

This is an important aspect to be addressed, and emphasizes the role of the teacher during all this process, not only as a mediator and advisor during the local exploration of the App, but also as an educator, responsible for the preparation of the activity and also for its' subsequent development in the classroom, in order to promote its integration in the learning process already in progress, and so to maximize its educational advantages. But in order to achieve this goal, promoting technology integration strategies in teaching practices and aligning these with the curriculum, teachers must acquire new technological and pedagogical skills (Cochrane, 2012; Wang, Hsu, Campbell, Coster and Longhurst, 2014).

Thus, professional development is key to helping teachers realize the potential of mobile learning (Ally, Grimus and Ebner, 2014). Because of both the pressure to provide teachers with effective technology integration skills and the rapid growth of mobile technologies as learning devices, teacher education programs need to implement theoretically and pedagogically sound mobile learning initiatives (Newhouse et al. 2006). Furthermore, it is important that teachers are motivated and supported by the school to integrate mobile devices in their teaching in order to be able to give the necessary support to students in their learning (O'Bannon and Thomas, 2014).

However, in Portugal, like in many other countries, the use of mobile devices in the classroom environment is prohibited in most schools. This prohibition of cell phone usage within schools is a particularly critical challenge with regard to the integration of mobile learning by teachers in their instructional activities, since it affects their attitudes regarding mobile learning in their classes or even prevent them from making any efforts to that end (Ismail, Azizan and Azman, 2013).

Finally, it should be noted that the use of mobile phones in field visits is itself a novelty for the students involved, they tend to be more motivated to perform activities and to learn. This aspect should be taken into account when considering the results presented and stressed the need of more studies to understand whether this novelty effect changes over time.

Acknowledgements

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