

The Use of New Learning Technologies in Higher Education Classroom: A Case Study

<https://doi.org/10.3991/ijep.v8i2.8146>

Micaela Esteves^(✉), Angela Pereira, Nuno Veiga, Rui Vasco, Anabela Veiga
Polytechnic Institute of Leiria, Leiria, Portugal
micaela.dinis@ipleiria.pt

Abstract—We have conducted a study with higher level education students, in lecture classes of three Undergraduate Courses and one Professional Higher Technical Course that involved six different subjects with a total of 324 students. In this research the use of Game-Based Learning platform was analysed in order to encourage the students' participation, increasing motivation and keeping them motivated and committed during lessons, therefore, increasing their learning skills. Based on these results, we recommend that Kahoot is used in lectures in order to help students develop their performances and abilities and at the same time be more successful and prepared to have an active participation in society.

Keywords—Learning, collaborative learning, game-based learning, higher education.

1 Introduction

During the recent years, there has been an increase in the participation rates of students in higher level education, mainly due to the Bologna process, and inevitably therefore an overall lowering of academic standards as universities and student populations have become more diversified [1]. There are still dedicated hardworking students in universities, however many of them have a low profile for higher education [2]. These changes have brought many challenges for teachers who have had to adapt their teaching methods according to students different characteristics and backgrounds.

In Portugal, as in other countries, the engineering areas deserve special attention from higher education institutions due to the low success rates and also because of the high dropout rate that is compared to other course rates. According to Paura and Arhipova [3] the main reasons for students' abandoning their studies is due to poor teaching and advising as well as the high difficulty level of the engineering curricula.

Mathematics, physics and computer programming are the main problematic subjects in the engineering curricula. In the literature some authors argue that the students' dropout rate depends on the subject and their qualifications obtained before university [4], [5]. On the other hand, today's students have a diverse practical knowledge and backgrounds that are often not recognized or underutilized by educa-

tors, namely their use of Information and Communication Technology (ICT). All these issues lead to a high dropout rate and failing, especially, in the engineering areas.

In these times of rapid technological changes, the challenge for today's teachers is to build a bridge between the technological world that students live in and the classrooms in which teachers expect them to learn in, especially in higher education. These students are being referred to as the Millennials [6] once they are the first generation to be immersed in ICT for their entire lives. Considine, Horton and Moorman [7] argue that *"to develop a curriculum that is relevant to this generation", educators need to acknowledge and respect the skills, attitudes, and knowledge that students bring with them to school and build on those to ensure success in the academic disciplines. Thus, students will become engaged and connected to the traditional curriculum while developing crucial technological skills."*

Due to the computerization society, education has been accompanying technological innovations. In this context, several digital applications for Game-Based Learning (GBL) purposes have emerged in higher education classrooms. These games should be aligned with the learning styles and needs of this current generation, the Millennials.

We propose the use of a GBL platform through mobile devices in the classroom to allow students to collaborate with each other, in order to encourage and increase their participation and motivation, during the lessons, therefore increasing their learning effectiveness. This paper includes a reflection on how using the game-based learning platform during lessons could improve learning experiences for students in higher education, mainly in engineering courses. In this context, this article presents the usage of Kahoot with higher education students from School of Technology and Management, Polytechnic Institute of Leiria, during the academic year 2016/2017 from September to May.

The rest of the article is organised as follows. Section 2 our motivation and related work is outlined. Section 3 describing the methodology of the project. In section 4 we follow with the findings and the discussion. Finally, some conclusions of this study are presented in Section 5.

2 Related work

Keeping Millennials students engaged in their education it is a hard task for educators. To overcome this challenge teachers have been analysing the gaming principles with the aim to use it in the education field. This new trend is known as Gamification and have been adopted by companies to increase engagement, brand awareness and loyalty [26]. Gamification is the process of integrate the games mechanisms (points, badges, levels, rewards, leaderboards, feedback, among others) into a new area, like an enterprise application, an online community or a website in order to motivate people to change behaviour in non-game environments.

One mechanism used by games is the visual progression. Gamers appreciate to see their progress, for example, through a level-up bar slowly being filled or changes on

the player's avatar. Also, students like to have an immediate result of their work rather than waiting a long time for the results [25].

The rewards is another mechanisms used in games to motivate the gamers to progress in the game. In education contexts, the use of a reward system encourages students to do their best and push them to overcome their limits [23].

The leaderboards used in the games is a public recognition of the gamer expertise. Also, the students like to be publicly recognized for their achievements, especially by their peers, i.e. their classmates.

The Massively Multiplayer Online Role-Playing Game (MMORPG) is one of most popular type of game genre. This gender of games allows players to cooperate and interact with people around the world that have the same interests [24]. In the classroom this effect can be applied if a task or project is accomplished in collaboration with others on a team. This can be magnified if they collaborate with teams from other schools or with teams from other countries.

The integration of games mechanisms into education, Game-Based Learning (GBL), can turn the lessons more interactive, interesting and effective. Since, this will involve a paradigm shift towards a more emphasis on student-centred learning instead of teacher-centred [2].

The usage of GBL has been explored in recent years for educational purposes due to the ability to commit students to the task that they are working on and pushing them to work to the edge of their capabilities [8], [9], [10], [11].

According to Whitton and Moseley [9] GBL has the ability to provide a scaffold for learners to gradually increase their knowledge and ensure that they are motivated to pursue additional content. Furthermore, games provide immediate feedback to the learners and can reinforce content and help students with the retention of concepts [12], [13].

The study carried out by Cheng and Su [14] makes a comparative study between traditional teaching methods and the Game-Based Learning (GBL) approaches. The results show that when using games, the students' motivation has a significant impact on learning, allowing us to assert that GBL can achieve the learning goal effectively.

On the other hand, GBL stimulates the collaboration between students. Collaborative environments can offer important support to students in their activities for learning. Collaborating in problem-solving encourage the reflection, since students communicate, argue and give opinions and this way enhances the learning process [15].

Nowadays, the students used their mobile technology not only for communicate with friends but also to study on homework assignments. The incorporation of student-owned mobile computing devices into the curriculum, Bring Your Own Device (BYOD), has helped to transform the instruction methods.

2.1 Game-Based Learning Tools

There are some Game-Based Learning tools that used the BYOD principles and allow to join the benefits of games and mobile technologies, such as EDPuzzle, Kahoot and Socrative.

EDPuzzle. The EDPuzzle tool allow teachers transform videos into an interactive and engaging lessons. With EDPuzzle (Fig. 1), it is possible to edit any video and insert questions, audio, text and links in different points. Teachers can share videos with the class, the students answer to questions and the teachers review the students' participation.

Students must create an EDPuzzle account and this way they have access to any video assigned to them in classroom or at home. Thus, teachers can monitor the individual progress of each student through the data provided on how each student answers to questions. This tool offers the possibility of flipping the classroom.

In EDPuzzle (Fig. 2), there is direct access to many of the more educational online sites, such as TED Talks, Khan Academy, National Geographic among others, which the teacher can choose the appropriate video to edit.

EDPuzzle has been used as a learning tool for teaching English as a second language [21]. Alvarado, Coelho and Dougherty [21] referred that students are motivated and engaged to learn and also appreciate the flexibility and autonomy provided by EdPuzzle as they are able to work independently. However, this tool has been used for learning other subjects but there is not available in the literature studies that prove their effectiveness.

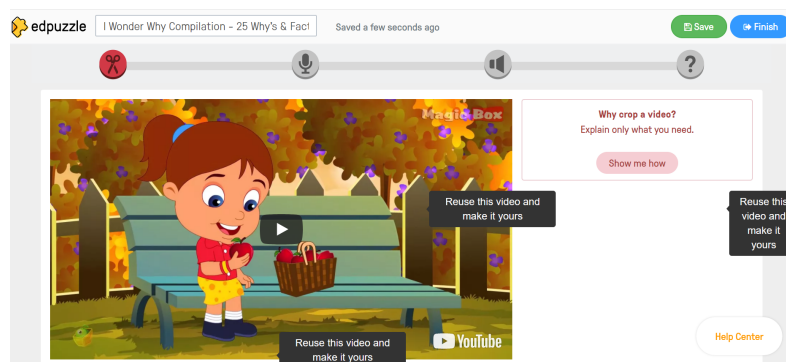


Fig. 1. Create an activity at EDPuzzle

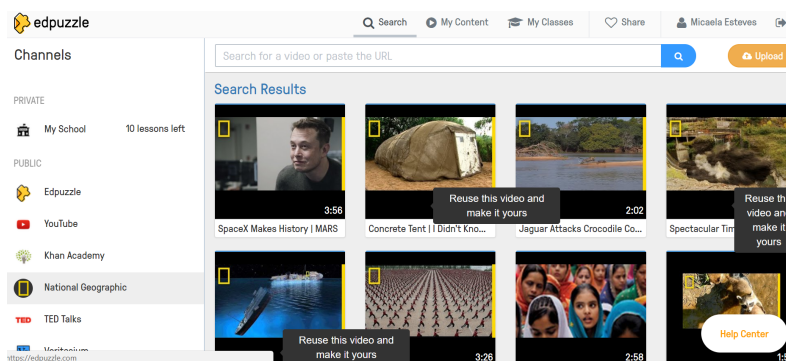


Fig. 2. EDPuzzle Educational resources

Kahoot. One educational tool that can be used to promote the collaboration in class is Kahoot. Kahoot is a game-based learning platform that has been used in university field studies in different areas such as Mathematics, Physics, Languages and others. Nevertheless, some authors [16] argue that using mobile technology does not guarantee effective learning.

Kahoot has been used in higher education context. Studies [17], [19] evaluating the usage of Kahoot, show that this is a good GBL tool for classroom activities and also helps to improve student participation by promoting a positive relationship between groups. On the other hand, Cerro Gómez [18] emphasizes that the usage of Kahoot has led to an increase in the number of students attending classes. Buchanan, Wolanczyk and Zinghini [20] argue that the existence of an alignment between the learning goals and the game design is important, which is possible to achieve whilst using the Kahoot GBL.

Kahoot has a free and a premium plus version. The premium version gives teachers access to a private organization area. The free tool has gained popularity amongst teachers for it being easy to use and its ability to establish dynamics of active work in the classroom. This application allows teachers to create quizzes, jumbles, surveys, discussions and also to obtain feedback from students in real time.

Through the Kahoot website (<http://kahoot.com>) the teachers create, manage and initiate the game. The student in a team or individual mode, interact with the game through the website (<http://kahoot.it>) or using the iOS or Android application. The Fig. 3 shows how students join the game and Fig. 4 shows students, through their own devices (smartphones, tablets or laptops) answer the questions that are projected on the classroom screen.

Socrative. Socrative is a game-based learning tool that allow teachers to generate activities for all kinds of electronic devices, such as laptops, tablets or smartphones. With this tool the students can actively construct their knowledge, compete and collaborate with each other. Socrative has quizzes and a space race. In quizzes the teacher creates questions that allow short answers and the space race is where student can form teams and compete against each other. With Socrative (Fig. 5) teachers can check the understanding of the student in class and created reports that can be downloaded and send by email or transfer to Google Drive.

According to Kokina and Juras [22] the use of Socrative has received positive feedback from instructors and students of Energy Business and Economic Development to teaching Accounting. Although, “*students react positively to the use of Socrative, the main challenge for the instructor is to make sure that the software enhances the learning process and does not become a distractor.*”

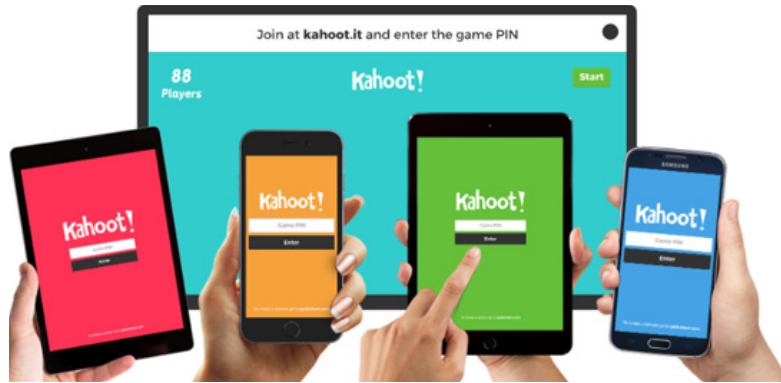


Fig. 3. Game beginning



Fig. 4. Students playing Kahoot

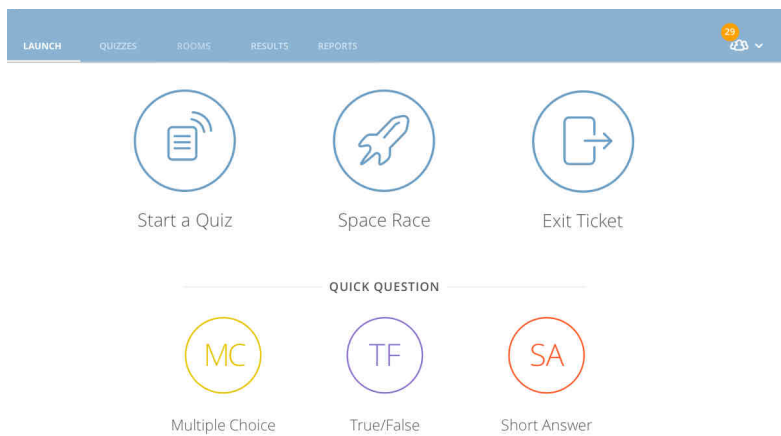


Fig. 5. Socrative Tool

Platform adopted. Although EdPuzzle is a platform very interesting for students learning it was not considering to be used in our study once it is mainly based in videos. The researchers consider it is not appropriated for this level of students, higher education and subject.

In Kahoot platform the gamification element is much stronger than in Socrative. Since, Kahoot added points to the game and after each question the students get the scoreboard and, also, receive a personal feedback like: “Congratulations Simon! You have 1200 points. You're at the 2nd place right after James at the 1st place. So simple and yet so clever!”

Kahoot has more gaming elements that make the students more engaging in learning. One of the elements is the goal that students must to achieve, other is the instant positive feedback and Kahoot give to students a challenge to keep them with a strong motivation for learning. The Fig. 6 represents the behaviour of students at the Kahoot end.

For all these reasons we decided to choose Kahoot as a Game-Based Learning tool in computer science classes in order to motivate the students.

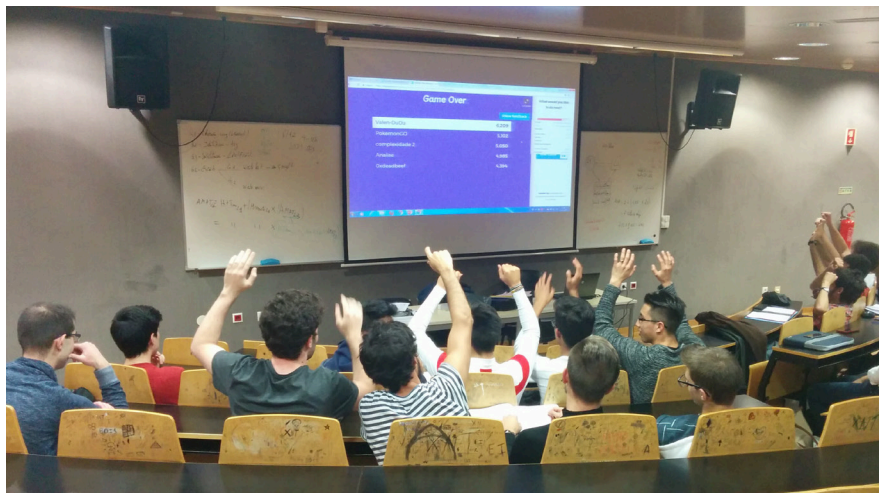


Fig. 6. Students behaviour at the Kahoot end

3 Methodology

This case study was carried out in the current school year, 2016/2017, in lecture classes of three Undergraduate Courses and one Professional Higher Technical Course and involved six different subjects with a total of 324 students. All subjects clearly fit into technological courses, with the exception of the undergraduate course, Health Information Sciences, which has also an interconnection with healthcare. All lecture classes lasted for 100 minutes, with the exception of one lasting only 50 minutes (Networks Laboratory I) and also had a different student attendance average.

Several Kahoot quizzes were applied in lecture classes and all of them were carried out with student teams. All Kahoot quizzes were always held at the end of the lecture, with the exception of Computational Systems (CmpS) subject. This allowed to validate the degree of attention and the consolidation of the contents from the students. In CmpS subjects with classes lasting 100 minutes, Kahoot was randomly interleaved as the lecture evolved. In addition to the previous objectives, this also allowed time to pause with the objective of regaining the students power of concentration and also to keep them motivated.

Three assessment methodologies (AM1, AM2, AM3) were chosen for evaluating the Kahoot effectiveness in the classroom (Table 1). The Comparison between the traditional approach versus Kahoot (AM1) was only performed on CmpS subject and was done by comparing the present subject student grades with those achieved in the preceding school year (without the use of Kahoot). This was possible because the students profile was identical in both years.

The analysis of the Kahoot approach acceptability and applicability was undertaken in two ways: team feedback (AM2) and an individual Kahoot survey (AM3). The individual survey included closed questions and open questions with regard to suggestions (Table 3).

Table 1. Overview of the case study.

Subject Acronym	Subject	Course	Average number of students in class	Assessment Methodologies
CmpAT	Computer Architecture and Technology	Undergraduate in Health Information Sciences	20	AM2 and AM3
CmpNT	Computer and Network Technology	Undergraduate in Games and Multimedia	41	AM2 and AM3
CmpS	Computational Systems	Undergraduate in Computer Engineering	177	AM1 and AM2
NLab	Networks Laboratory I	Computer Networks and Systems Professional Higher Technical Course	25	AM2 and AM3
SoilMF	Soil Mechanics and Foundations	Undergraduate in Civil Engineering	14	AM2
VirtT	Virtualization Technologies	Undergraduate in Computer Engineering	47	AM2 and AM3

4 Results and discussion

4.1 Comparison between the traditional approach versus Kahoot

In the subject of CmpS, the average theoretical grade has improved by 6.4%, from 8.86 out of 20 in the 2015/2016 school year (without Kahoot) to 9.57 in 2016/2107 (with Kahoot). There were no other significant changes in the operation of the subject, with contents and the teaching team remaining the same.

It should also be noted that there is a higher impact on lower grades with the failing students' scores improving 12%, from 6.17 out of 20 to 6.91, closer to success. The positive average rose 2.8% (Fig. 7).

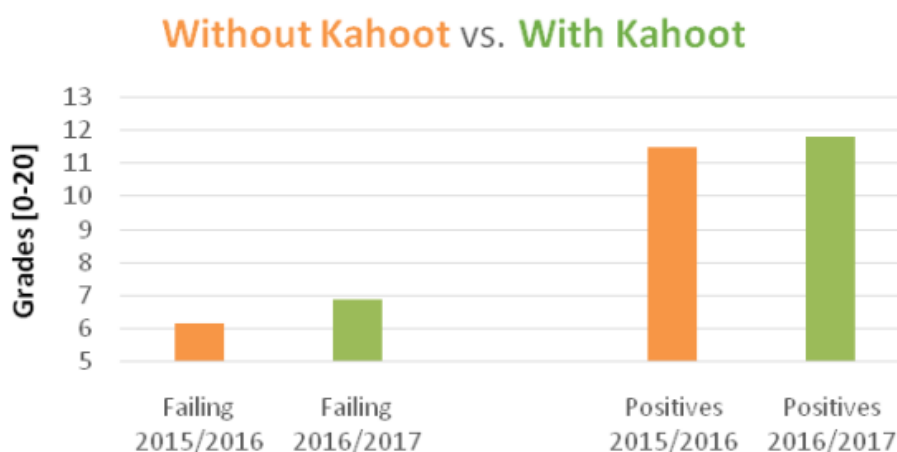


Fig. 7. Student average results [0-20] without and with Kahoot.

These results are in line with the study carried out by Cheng and Su [14] showing the effectiveness of the tool in the learning process. Teachers could observe the positive impact on students' motivation. As for a possible cognitive influence assessment, more studies will be necessary in the future.

4.2 Analysis of the Kahoot approach acceptability and applicability

With regard to the analysis of Kahoot applicability (Table 2) the results show that there is a high percentage average of correct answers of the three best teams, despite the fact that they have been evaluated right after the presentation of the contents, therefore without prior study. Thus, we believe that Kahoot can help students focus in class.

Some teams revealed difficulties in accessing Kahoot, either due to Wi-Fi problems or lack of hardware capacity, causing some teams to be unable to answer a considerable amount of the questions, being evaluated as "wrong" answers. This may partly explain the significant difference of the overall average (61%) in item 1 (Table 2) "Correct answers" to the 1st place average (86%) in item 1.1.

The results also emphasise the high average values of positive feedback, revealing a clear impact on student motivation. We highlight the medians of 100%. About the Kahoot acceptability the majority of students approved and appreciated it. However, 15% do not feel so comfortable with the use of this application.

Table 2. Results of Kahoot acceptability and applicability

Item	Average	Standard deviation	Median
1. Correct Answers	61%	13%	61%
1.1. Correct answers of 1 st place	86%	19%	89%
1.2. Correct answers of 2 nd place	79%	19%	75%
1.3. Correct answers of 3 rd place	73%	23%	73%
2. How fun was it? (1 to 5)	4.3	0.5	4.4
3. Did you learn something?	92%	13%	100%
4. Do you recommend it?	94%	10%	100%
5. How do you feel?			
5.1. I feel Positive	75%	20%	78%
5.2. I feel Neutral	11%	11%	11%
5.3. I feel Negative	15%	16%	13%

In order to better understand the students' acceptance of Kahoot, we underwent satisfaction survey that was answered by 84 students, 23% of the students were female and 24% of the students attend the CmpAT subject. The survey results are presented in Table 3.

The analysis of the ease of technology handling by the students, reflects their digital skills. The survey results corroborate that the use of Kahoot contributes to consolidate students' knowledge. Concerning the time available per question and the quantity per Kahoot it was considered adequate. The results about the importance of podium and the reward attribution were not consensual once they present high standard deviations. This reveals that students do not give importance to the prize but rather to the pleasure of playing.

Table 3. Results of individual survey

Questions	Average (1 to 5)	Standard deviation	Median
1. Do you feel comfortable using electronic gadgets (smartphones, tablets, laptops, ...)?	4.60	0.56	5
2. Does Kahoot contribute to the consolidation of the subject contents?	4.12	0.66	4
3. Will Kahoot contribute to better individual grades?	4.05	0.58	4
4. How fun was it?	4.37	0.77	4.5
5. Was the Kahoot question response time adequate?	3.02	0.38	3
6. Was the Kahoot number of questions adequate?	2.94	0.32	3
7. How important is the scoreboard?	3.68	0.97	4
8. Do you agree with the reward?	3.43	1.00	3
9. Do you recommend Kahoot?	4.30	0.70	4

Having only a few students answer the comments section. Those who did, were in general enthusiastic about using Kahoot and encouraged the continuation of its usage, as can be seen in the following answers examples: *“I loved Kahoot!”*; *“At the beginning Kahoot seemed like a joke, but then I realized its great benefits. Thank you!”*;

“The subject contents are hard and very theoretical. Kahoot helped a lot lightening the burden.”; “A good interaction moment and a fun way of reflexion on the contents.”; “Strengthening of team work and relationship between fellow students”.

5 Conclusions and Suggestions

Currently, educators are facing difficult times with a whole generation that was born surrounded by technology and that are subject to completely different stimuli from their teachers and parents. Researchers have recognized that these students learn differently thus teaching should adapt to avoid abandonment and improve the success of these digital natives.

The result of this study shows that students are more committed to learning in the classroom. Moreover, the number of students per class increased, softening a problem in our institution. Consequently, the learning results were better therefore it is our intention to spread the use of Kahoot in classrooms of other courses.

In this study, Kahoot was used as a way to assess and consolidate contents, as well as a way to regain power of concentration. However, we suggest other forms of using it: in the beginning of the next class to access and consolidate the contents of the previous class or simply as a diagnostic test, allowing the teacher to know the students' previous knowledge about the subject and motivating them to the learning process.

Based on our experience in teaching in higher education, we believe that using this type of applications could reduce the gap between student's way of life and the classroom environment, once mobile technology is intricately interwoven in their lives.

6 Acknowledgments

This study had the support of FCT – Fundação para a Ciência e a Tecnologia, I.P., to strategy project n° UID/CEC/04524/2016 granted to CIIC.

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8 Authors

Micaela Esteves, PhD is an Associate Professor of Computer Science, member of Computer Science and Communication Research (CIIC) of School of Technology and Management of the Polytechnic Institute of Leiria, Rua General Norton de Matos, 2411-901 Leiria, micaela.dinis@ipleiria.pt, Portugal.

Angela Pereira, PhD is an Associate Professor of Computer Science, member of Tourism Applied Research Centre (CiTUR) of School of Tourism and Maritime Technology of the Polytechnic Institute of Leiria, Rua General Norton de Matos, 2411-901 Leiria, angela.pereira@ipleiria.pt, Portugal.

Nuno Veiga, is an Associate Professor of Computer Science, member of Computer Science and Communication Research (CIIC) of School of Technology and Management of the Polytechnic Institute of Leiria, Rua General Norton de Matos, 2411-901 Leiria, nuno.veiga@ipleiria.pt, Portugal.

Rui Vasco, is an Associate Professor of Computer Science, member of Computer Science and Communication Research (CIIC) of School of Technology and Management of the Polytechnic Institute of Leiria, Rua General Norton de Matos, 2411-901 Leiria, rvasco@ipleiria.pt, Portugal.

Anabela Veiga, PhD is an Associate Professor of Civil Engineering of School of Technology and Management of the Polytechnic Institute of Leiria, member of Geosciences Center of the University of Coimbra, Rua General Norton de Matos, 2411-901 Leiria, anabela.veiga@ipleiria.pt, Portugal.

Article submitted 20 December 2017. Resubmitted 05 January and 25 January 2018. Final acceptance 05 April 2018. Final version published as submitted by the authors. This article is a revised version of a paper presented at the International Conference on Interactive Collaborative Learning (ICL2017), held September 2017, in Budapest, Hungary.