E-DUCATION PLATFORM IN A CLASSROOM CONTEXT

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Abstract

This work aims to develop and implement a multidisciplinary didactic platform to support teaching activities in the Portuguese 1st cycle education, elementary school. The goal is to ascertain the importance of using didactic games in the consolidation of school contents and, as a consequence, to foster the learning process. The platform consists of a set of five modules that communicate with each other and generating a pedagogical background. Thus, the child interacts with an environment of light, movement and sound, specially thought and created in order to attract child’s attention to the acquisition of problem-solving mechanisms. In the main module, it is created an activity in which the main character moves along a course, where it must overcome several obstacles to reach the end of the excursion with success. The other four modules are didactic games related to the 1st cycle disciplinary program, Mathematics, Science, Portuguese and English topics, with particular challenges to enable the child to develop the desired thinking mechanisms. Throughout the interaction, the child adds points and the time for solving the problem is registered. The tests of the platform were carried out in the EB 1 School of Macieira de Rates, Barcelos, Portugal, with students of the 1st cycle. The students and teachers were very enthusiastic and curious about the E-ducAtion platform. Analyzing the results obtained, it can be concluded that the platform had a very positive impact in the communities, both in terms of motivation and learning.

Keywords: Educational automation and robotics, Multidisciplinary games, Teaching-Learning, 1st cycle study.

1 INTRODUCTION

Teaching/learning issues, from the earliest years of learning to attending higher education, have been discussed in the scientific community. In fact, already in the first cycle of basic education, teachers point out realities and difficulties. Some of the contents of the 1st cycle are difficult to understand because they are abstract, which often causes an obstacle to student learning. Students also have different learning abilities/skills/rhythms that require more or less extra support. Another evident problem that has become increasingly difficult to combat is the students’ lack of attention in class. With the numerous distractions to which the students are exposed these days, it is increasingly difficult to combat this problem. Another situation today is the availability of digital games compared to “hard” games. With digital games through a click, the student can navigate through a variety of games. On the other hand, having a visual and physical perception of the phenomena helps the student to have the most present concepts. Also, the lack of kits that sensitize children to real-world problems and that require a constant student-play interaction leads to children feeling the lack of something innovative that captures their attention to the contents [1-10].

Over many years, curricula have become more and more extensive and their complexity has increased. Consequently, the constantly evolving technological world has entered into the daily lives of students in the 1st cycle. These technologies with a strong pedagogical component can also be a source of distraction for students. Through these technologies such as tablets, mobile phones and consoles, students devote much of their time to games. On the other hand, the lack of attention of the students in the room did not undergo major changes. Teachers in the 1st cycle continue to have many difficulties in keeping students mindful of the content and motivating them for classroom activities. These factors mean that the student’s performance is not optimized, and this may have consequences for their professional success [9-11].

Following this trend, the main objective of this work is to develop a multidisciplinary didactic platform to support the first cycle education, E-ducAtion platform. In addition to the implementation of the teaching support platform, it is important to verify if the developed platform is really effective in the development
of cognitive and stimulation capacities in the 1st cycle students. Thus, the platform was made available in schools in the municipality of Barcelos for tests. An analysis of the various solutions available makes it possible to conclude that none fulfills all the functionalities that the EducAtion platform intends to integrate [12-28].

2 METHODOLOGY

EducAtion platform, a tool to support teaching for the first cycle, Figure 1, implements four didactic games and a board where the action takes place. The entire platform interacts with the user through lights, sounds and movements. After the student solves a game, he/she is allowed to solve the next game and thus until the end of all the adventure that takes place in the central board. In this adventure the character must avoid obstacles and displace personages along a course allusive to the city of Barcelos. In the platform, a data recording system was implemented that collects all the information regarding the performance of the platform by each student. An identification system was implemented through a tag reader to create and record the performance of each student.

2.1 Central Board

In the Central board is where the main action takes place. There are two roosters that run along two separate tracks. The goal is for the yellow rooster to reach the goal first than the black rooster. The yellow rooster corresponds to the character of the student while the black rooster corresponds to the character of the platform. Roosters are the main symbol of the city of Barcelos. Along the way there are some obstacles that the student will have to remove. To remove obstacles the student has to solve the game associated with each obstacle. Like the roosters, the whole decoration of the board was inspired by the city and elaborated by a craftsman of the city. This decoration, in paper pulp, involves constructions with the typical architecture of the city, such as the Portuguese sidewalk, historical buildings (such as the river waterfowl) and traditions (such as the arches that are exhibited every year at city festivities). Figure 2 left shows the appearance of the central tray.

In Figure 2 right are presented all the modules responsible for the operation of the platform. In the first module, (1) eight-tab switches are used to define the eight positions that the two characters can take. In the second module (2) five servomotors are used to control the four obstacles that are arranged along the path. The third module (3) is responsible for storing the data and consists of an Arduino module SD card. The fourth module (4), set of two push buttons and a yellow LED, serves for the student to give the opinion if he/she did (not) like using the platform. In (5-8) are the four modules/games that send the performance information to the processor. In (9) is an Arduino UNO that serves to control the platform music and the tag reader. This module is controlled by the central Mega Arduino. (10) is a DFPlayer Mini MP3 with SD card support, which will allow you to play music on the platform. Coupled to this module is a speaker to output the sound (11). The twelfth module is a tag reader (12) that is responsible for the identification of the student and to it are associated the respective tags of each student (13). In the fourteenth module (14) are the two motors responsible for the movement of the two characters, the Nidec engines. Finally, the fifteenth module consists of two groups of two LEDs of the same color (15). These LEDs will turn green if the student wins the game or red if the student misses the game. In the SD card placed on the board are stored the data of the students who used the platform. The system creates a file for each student, with the name of the student. Within each file, information about student performance in the use of the platform is stored. If the student later uses the platform again, the new
data will be added to the file. Thus, it is possible to obtain the profile of the student's performance. When
the game is started, the platform is in standby mode and the red LED next to the tag reader flashes.
Thus, the student intuitively understand that he/she will have to identify himself, passing the tag on the
reader, before starting to play. When the student successfully identifies himself, the red LED goes out
and green lights up. The system has a set of restrictions to limit students who have access to the
platform. In this way, only authorized students can play. These limitations can be easily changed by
adding and removing students.

2.2 Portuguese Game

In the Portuguese Game, students are expected to develop language comprehension skills. There is
a holder to fit the plates where challenges are written. These plates are recognized and interpreted
inside the box. The yellow colour on the upper part is used so that the plaque is identified with the
support so that plaques between the games are not exchanged. Once the boards are inserted, they
are identified, and the system waits for the student to respond to the problem. Figure 3 left presents
the Portuguese Game.

In Figure 3 right are the modules responsible for the operation of the Portuguese game. The first
module consists of 20 pushbuttons (1). These buttons will be used for the student to give the answer
to the problem. The second module consists of 5 optical sensors (2). These sensors are used to
identify the board that the student placed in the game. A 5-bit torque recognition system is used, one
for each sensor. Through the slots of the boards the system has active bits and manages to know
which board is placed in the game. The third module consists of a sound column that is responsible
for emitting the sounds of the game (3). The fourth module (4) consists of 3 signaling LEDs to indicate
if the student gave a wrong answer (first red LED), if the student took longer than he/she should
(second red LED) and if the student gave the correct answer (third LED green). The fifth module
consists of two signaling LEDs to indicate that the board is correctly positioned, and that the system
recognizes the board (5).
2.3 Math Game

In the Mathematics Game, it is intended that students develop representation skills and operations with fractions. There are plates that are embedded in the holder. The blue colour at the top is for the board to be identified with the bracket so that boards are not exchanged between the games. Once the boards are inserted, they are identified, and the system waits for the student to respond to the problem. Figure 4 left presents the Mathematics Game.

In Figure 4 right are the modules responsible for the operation of the Mathematics Game. The first module consists of 100 blue LEDs (1). These LEDs are lit in proportion to the fraction chosen by the student. The second module consists of 5 optical sensors (2). These sensors are used to identify the board that the student placed in the game. A 5-bit torque recognition system is used, one for each sensor. Through the slots of the boards the system has active bits and manages to know which board is placed in the game. The third module consists of two rows of lever buttons (3). These buttons are connected in series with the 100 LEDs grouped in groups of 5 LEDs, each button illuminates 5 LEDs. The fourth module consists of a push-button (4) that serves for the student to submit the final answer. The fifth module consists of a sound column that is responsible for emitting the sounds of the game (5). The sixth module consists of 3 LEDs to indicate if the student has given a wrong answer (6). In the first red LED, if the student took more time than he should on the second red LED and finally if the student gave the correct answer on the third green LED (4). The seventh module consists of two LEDs indicating that the board is correctly positioned, and that the system recognizes the board (7).

2.4 English Game

In the English Game it is intended that students develop foreign language ability and associate concepts to figures. To start the game, it is necessary to put in the holder, the board with an image in the box of the game. Then the game will randomly select one of the ten issues associated with the image. Once the question is selected, the student has to look at the picture and get the answers from the picture. After knowing the answer, the student has to press the pushbutton corresponding to the correct answer. Figure 5 left presents the English Game.

In Figure 5 right are the modules responsible for running the English game. The first module consists of 10 yellow LEDs (1). The second module consists of a sound column that is responsible for emitting the sounds of the game (2). The third module consists of 2 optical sensors (3). These sensors will be used to check if there is any image plate placed in the game. A 2-bit torque recognition system is used, one for each sensor. Through the lateral grooves of the boards the system has n active bits and manages to know if the board that is placed in the game. The fifth module consists of 3 signaling LEDs to indicate if the student gave a wrong answer on the first red LED, if the student took more time than he should on the second red LED and finally if the student gave the correct answer on the third green LED (4). The seventh module consists of two LEDs indicating that the board is correctly positioned (6).
2.5 Science Game

The Science Game intends that the student acquire competences in the scope of the sciences being able to be extended to several concepts like plants, animals, rivers, among others. In this game it was implemented the game to label parts of the human body. When game starts the LEDs that signal the part to be labeled will light sequentially. This effect gives the sensation that the image is swallowing some food and is intended that the student understands that it is before the digestive system. After a few seconds, only one LED starts burning. Then the student give the answer in one of the buttons of the right side indicating which organ of the corresponding digestive system. Figure 6 left shows the Science Game.

In Figure 6 right are the modules responsible for the operation of the game. The first module consists of 10 yellow LEDs (1). The second module includes a sound column that is responsible for emitting the sounds of the game (2). The third module consists of 10 pushbuttons (3). These push buttons are used to give the answer. The fourth module (4) consists of 3 signaling LEDs to indicate if the student gave a wrong answer (first red LED), if the student took longer than he/she should (second red LED), and if the student gave the correct answer (third LED green).

2.6 Platform Operation

The platform is turned on and the program starts running on the Arduino. Initially it will check if the characters are in the reset position. If they are, the system lowers all obstacles and waits for student identification. If they are not in the reset position, all obstacles are lifted. Then it moves character1 and 2 to the reset position. After both are in the reset position, all obstacles are placed. At this point the system stays in stand-by while the student does not pass the tag in the tag reader. Once the student is identified, game 1 is enabled, it is possible to start playing. The student begins to play and as soon as he/she gives a wrong answer the character 2 will move. If the student takes more time than the time allowed to solve the game, character 2 will also move. When the sum of the movements of character 2 is greater than five, the student loses the game. After all the obstacles are raised and the character 2 reaches the goal first that the character 1. The student cannot perform more than five movements with
the character 2. The process is repeated for all games. When the student arrives at the last game, if he/she answers correctly within the expected time, he/she wins the game. Character 1 will move to the target. After that, character 2 moves to the goal as well. When the two characters are already in the goal the platform waits for the student to give his/her overall appreciation of the platform. Finally, all data is stored on an SD card. The program ends and returns to the beginning.

2.7 Tests Procedure

To validate and measure the efficiency of the E-ducAtion platform, tests were carried out at three elementary schools of the municipality of Barcelos, Portugal.

Initially an explanation was given to students about the platform and what was its purpose. Then each student individually tried out the platform. The platform was placed in the library of the schools which allowed the students to solve the problems in a calm and educational environment. Before carrying out the tests, five minutes of conversation were dedicated to each student in order to make him/her more comfortable and calmer. While the students solved the games, the researcher analysed some particular behaviours and pointed out in a notebook. At the end, each student fulfilled a questionnaire about their experience with the platform. After that, there was a meeting with the teachers in order to obtain their feedback.

The tests were performed in two phases. First, the Portuguese, Mathematics and English Games were tested with a population of students from the Rosa Ramalho School Group. A total of 25 students, including 11 boys and 14 girls, were surveyed. The minimum age was 8 years and the maximum age was 9 years.

In the second phase the E-ducAtion platform with the four games were tested with a population of 19 students, 11 girls and 8 boys. The average age was 8 years and the oldest student was 9 years old and the youngest 8. According to the teacher accompanying the class, the students present many difficulties in acquiring knowledge.

For a quantitative evaluation of the platform were created the metrics listed below:

- Resolution time of each game;
- Number of wrong attempts in each game;
- Classification of game with a value from 0 to 10, where 0 corresponds to the most negative classification and 10 corresponds to the most positive classification;
- Classification of the difficulty of each game with a value from 0 to 10 where 0 corresponds to the most negative classification and 10 corresponds to the most positive classification;
- Classification of the aesthetic aspect of each game with a value from 0 to 10 where 0 corresponds to the most negative classification and 10 corresponds to the most positive classification;
- Student prefer to play to go to the class-break (yes/no answer);
- Student would like to have this game at home (yes/no answer);
- Students believe that the games are motivating (yes/no answer);
- Students prefer to learn with games than in the traditional context of the classroom (yes/no answer).

3 RESULTS

This section presents some of the results obtained at the basic schools of Carvalhal, Alvelos and Macieira de Rates, from the city of Barcelos, Portugal.

3.1 Basic School of Carvalhal and Basic School of Alvelos

From Figure 7 it is possible to obtain an overall information of the incidence of the three games tested. Clearly students prefer to use educational games and use them in the classroom.

A significant part of the students felt motivated to perform the games. In terms of difficulty through Figure 7 one can conclude that the level of difficulty is adequate.
Figure 8 compares students' opinions about the preference between didactic and digital games, taking into account the experience of the same students with both types of games. Although they have more experience with digital games, students prefer teaching kits. Possibly because they are new and, as such, they are a challenge.

### 3.2 Basic School of Macieira de Rates

In Figure 9 the students assessed each of the parameters from 0 to 10. Through the analysis of the figure it can be concluded that in general students liked the obstacles and the way they moved. Also the course and the characters of the game had a very positive evaluation.

The students were also asked about the effects of the platform and what they felt when performing this experiment. Figure 10 shows the answers given by students. For most students, interest in content and the platform increased. On the other hand, these students suggest that the platform should have more
games with more content. The sound system is suitable for the platform and its activities. The fact of playing benefited some students with more difficulties and allowed the more prepared students to collaborate with them. Thus, the spirit of teamwork and cooperation among students was also developed to achieve the objectives. These students recognized that this benefited the students.

After the overall tests in the several schools it was verified that most students prefer to learn with educational games than with digital games. These students liked to have these games at home. In this way, they could spend more time in contact with the platform and develop more skills.

As for preferring to play or take a break, the students divided their opinions and approximately half of the students would rather continue to use the platform.

These tests in the various schools involved socially and culturally from various institutions such as the Municipality Council of Barcelos, the Parish Council of Macieira de Rates and the Rosa Ramalho School Group, which gave a very positive appreciation.

4 CONCLUSIONS

The E-ducAtion platform is a multidisciplinary didactic platform for the Portuguese 1st cycle education. The objective is to captivate the interest of the students to the learning contents, presenting this platform as a complement to the traditional learning and to the use of digital methods.

Tests were carried out in three schools in the municipality of Barcelos, the Basic School of Macieira de Rates, the Basic School of Carvalhal and the Basic School of Alvelos. In the Basic School of Carvalhal and in the Basic School of Alvelos were validated the games of Portuguese, Mathematics and English which allowed a first validation of the platform. The entire platform was tested in the School of Macieira de Rates. The tests were carried out in the classroom with the 1st cycle students. Students were asked to use the platform and to answer some questions related to the contents of the school program. According to the school teachers the students felt very motivated, interested and willing to try the platform again with new games and new challenges.

The results obtained were fundamental to gauge the effect and the potentiality of the platform. Through these it was possible to conclude that, in general:

- Students like to have several options to learn subjects and are receptive to new methods;
- The interaction between the game and the students is fundamental to maintain attention and interest in the subjects;
- The expectation of taking a course and observing the movement of the characters and obstacles engage students in the activity;
- The students are available to experiment with alternative solutions to digital games and recognize that they may be useful to them.

The design of the platform was based on modularity in order to facilitate the development of new games and activities for the same central board. Also, an online platform monitoring system could be developed in the future through an online server that would store student data and perform a statistical analysis of
the data. In this way, through a website and a login to this site, the teacher would have access to all information already treated.

A future challenge is to develop a platform with several characters to play at the same time with each other with a student to "control" each character. This will create a more elaborate setting to implement collaborative learning.

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